Engineering Library

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The Engineer

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PUBLIC NOTICES

Air Ministry.
DIRECTORATE OF TECHNICAL DEVELOPMENT.

TEST ASSISTANTS REQUIRED at the Royal Aircraft Establishment as follows:—

REF. No. A. 443.—One for calculation and experimental work in connection with aero-engine investigations.

REF. No. A. 442-4.—Two for work in connection with the technical development of aeronautical instruments and small precision apparatus.

REF. No. A. 448.—One for work in connection with strength tests and experimental work on aircraft structures and materials.

Candidates should have had works and drawing-office experience and technical training to the standard of B.Sc. Degree, and for posts A. 442-4 some laboratory experience would be an advantage. Candidates for posts No. A. 443 and A. 442-4 should also be medically fit for flying and be willing to fly as observers.

Preference given, other things being equal, to ex-Service men.

Starting salary from 50s. to 60s., plus Civil Service bonus, a week (present equivalent total remuneration £3 17s. 3d. to £4 10s. 3d.).

Write (quoting appropriate reference numbers), stating age and full particulars of training, qualifications and experience, to the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants. 5589

Air Ministry.
DIRECTORATE OF TECHNICAL DEVELOPMENT.

DRAUGHTSMAN, Grade II., REQUIRED at the Royal Aircraft Establishment, for work in connection with Technical Publications. Candidates should have a good general knowledge of Aircraft and Aero-engines, ability to prepare perspective sketches suitable for reproduction in technical handbooks, and to build up perspective illustrations from workshop drawings.

Starting salary £150 plus Civil Service bonus a year, giving a present total remuneration of £226 10s. a year on the scale £150-£7 10s.-£175 plus bonus a year.

Preference given, other things being equal, to ex-Service man.

Apply (quoting Reference No. A. 450), stating age and full particulars of training and experience, to the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants. 5604

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POSTS:—

M/1990.—ASSISTANT ENGINEERS REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree or obtain such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case, or have completed articles with a Civil Engineer of good standing, and have passed Sections A and B of the examinations for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of Civil Engineering under a qualified civil engineer.

M/2358.—ASSISTANT ARCHITECT REQUIRED by the GOVERNMENT of PALESTINE for two to three years' service. Salary £700 to £900 a year, according to qualifications. Free passages and at termination of contract leave on full salary in England for six weeks for each year of service. Candidates, 30-50 years of age, should have had experience in a first-class office and have superintended building works of some importance. Must be capable of superintending the construction of a public building estimated to cost £200,000 and to take charge of the drawing-office work in connection therewith.

M/2407.—ASSISTANT MARINE ENGINEER DRAUGHTSMAN REQUIRED by the SINGAPORE HARBOUR BOARD for three years' service and possible extension. Salary 400 dollars, rising to 450 dollars by annual increments of 25 dollars a year. Free passages. Candidates, 25 to 30 years of age, preferably unmarried, must have a first-class general knowledge of the design and construction of all classes of Marine Engines, Boilers, Auxiliaries and Machinery.

M/2402.—CIVIL ENGINEERING DRAUGHTSMAN REQUIRED for the KENYA and UGANDA RAILWAY for a tour of 20 to 30 months' service and possible extension. Free quarters and passages and liberal leave on full salary. Salary £300, rising to £372 a year by annual increments of £18, with prospects of promotion to a salary scale of £390, rising to £480 a year by annual increments of £18. Candidates, unmarried, 25 to 30 years of age, must have had good experience of Civil Engineering Draughtsmanship upon a railway, including experience of Estimating, Track Layout, Steel Work Design, &c.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, noting the reference number against the appointment for which application is made. 5602

University of Manchester.
DEPARTMENT OF ELECTRICAL ENGINEERING.

DEPARTMENTS OF CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.

Full particulars of these Courses will be forwarded on application to the REGISTRAR.

The SESSION COMMENCES on THURSDAY, OCTOBER 2nd. 5579

Ministry of Transport.
ROADS DEPARTMENT.

APPLICATIONS are INVITED for a POST as ASSISTANT at the Ministry's Road Experimental Station at Harmondsworth, near Colnbrook, Middlesex, on the scale of salary £175-15-235 plus the usual Civil Service bonus, liable to variations with the cost-of-living index figure. The present bonus on £175 is £90, which will be reduced to £84 on the 1st September next. The selected candidate would enter the scale at the minimum.

Candidates should possess an Engineering Degree or an Honours Degree in Physics, with experience in research work. The duties include the study and measurement of the resistance to skidding exerted by different types of road surfaces. Preference will be given to men who have served in His Majesty's Forces.

Forms of application can be obtained from the ESTABLISHMENT OFFICER, Ministry of Transport, Whitehall-gardens, S.W. 1. Applications can only be received on the recognised forms and should reach the Ministry of Transport on or before the 25th August, 1930. 5596

North-East Coast Institution
OF ENGINEERS AND SHIPBUILDERS.

GEORGE MITCHELL HARROWAY SCHOLARSHIP.

ENTRIES are INVITED for the GEORGE MITCHELL HARROWAY SCHOLARSHIP. These should be addressed, not later than the 22nd September, to the undersigned, from whom full particulars of the Scholarship may be obtained.

The Scholarship is of the value of £100 and is tenable for three years at one of the Universities at which Shipbuilding and Marine Engineering subjects are taken.

Candidates must be natives of Blyth or Middlesbrough, of not less than 17 or more than 19 years of age, and have served at least one year of an apprenticeship in shipbuilding or marine engineering.

Candidates must have passed an examination of recognised matriculation standard.

There will be no examination in specific subjects, but candidates who fulfil the Scholarship regulations will be required to present themselves for interview by the Selection Committee.

E. W. FRASER-SMITH,
Secretary.
Bolbec Hall, Newcastle-upon-Tyne. 5573

University of Manchester.
PHYSICS DEPARTMENT.

Full particulars of the LECTURES and LABORATORY COURSES in PHYSICS, preparing for both the Ordinary and Honours Degrees will be forwarded on application to the REGISTRAR.

The SESSION COMMENCES on THURSDAY, OCTOBER 2nd. 5578

Robert Gordon's Technical
COLLEGE, ABERDEEN.
(CENTRAL INSTITUTION.)

The Court of the University of Aberdeen and the Governors of Robert Gordon's Colleges co-operate in the provision of courses leading to the Pass and Honours Degrees of B.Sc. (Engineering) of the University and to the Associateship of the Colleges in the Departments of:—

CIVIL ENGINEERING,
MECHANICAL ENGINEERING,
ELECTRICAL ENGINEERING.

Full-time Day Courses in Mechanical and Electrical Engineering lead to the Higher National Diplomas in these subjects.

Prospectuses forwarded gratis on application to the SECRETARY and REGISTRAR, Robert Gordon's Colleges, Aberdeen. P56

Great Western Railway—
SWANSEA DOCKS.
KING'S DOCK—NEW ENTRANCE LOCK.

The Great Western Railway are prepared to receive TENDERS for the CONSTRUCTION of a NEW ENTRANCE LOCK to the KING'S DOCK at Swansea.

The specification, schedule, form of Tender and other particulars can be obtained from Sir Alexander Gibb and Partners, Queen Anne's Lodge, London, S.W. 1, and drawings can be inspected at the same address, on or after 15th August, 1930.

A deposit of £15 15s. will be charged for the documents, and this will be returned on receipt of a bona fide Tender by the date below mentioned.

Sealed Tenders, endorsed "Tender for New Entrance Lock, Swansea," must be delivered to the SECRETARY of the GREAT WESTERN RAILWAY COMPANY at Paddington Station, London, W. 2, not later than Tuesday, 16th September, 1930.

The Company do not bind themselves to accept the lowest or any Tender. 5566

PUBLIC NOTICES

Bombay, Baroda and Central
INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Wednesday, 17th September, TENDERS for the SUPPLY of:
1. STEEL MATERIAL (PLATES, ANGLES, FLATS, SQUARES, ROUNDS, &c.);
and up to Noon on Wednesday, 3rd September, TENDERS for the SUPPLY of:
2. STEEL TYRES for LOCOMOTIVES.
3. STEEL BOILER, FLUE and ARCH TUBES and STEAM PIPES.
4. WOODWORKING MACHINES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each for Nos. 1 and 2, and 10s. each for Nos. 3 and 4 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.
Offices: The White Mansion, 91, Petty France, Westminster, S.W. 1, 13th August, 1930. 5597

Borough of Bangor (County DOWN, IRELAND).
MAIN DRAINAGE, CONTRACT I.
TO CONTRACTORS.

The Council of the Borough of Bangor invite TENDERS for the CONSTRUCTION of about 2700 YARDS of 7in., 9in., 12in., 15in., 18in., 21in., and 27in. STONEWARE and CONCRETE TUBE SEWERS; 1300 YARDS of 48in. by 32in. CONCRETE EGG-SHAPED TUBE SEWERS, together with MANHOLES, FLUSHING TANKS and VENTILATING SHAFTS; the CONSTRUCTION of about 1150 YARDS of 6in. and 18in. CAST IRON PUMPING MAINS, and about 30 YARDS of 30in CAST IRON OUTFALL SEWER: for the ERECTION of THREE SMALL PUMPING STATIONS, SUCTION and PUMP CHAMBERS; the ERECTION of a STORAGE TANK with SCREEN HOUSE, PUMP and SUCTION CHAMBERS and other appurtenant WORKS, all in accordance with plans and specification prepared by the Engineers, Messrs John Taylor and Sons, Caxton House, Westminster, London, S.W. 1.

Copies of the specification, bill of quantities and form of Tender may be obtained from the offices of the Engineers upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.

Drawings may be seen at the offices of the Engineer or at the office of the Surveyor, Town Hall, Bangor, Co. Down, Ireland.

The works are for the relief of the unemployed, and the contract will be subject to special conditions laid down by the Ministry of Labour, Northern Ireland, for public utility schemes.

Sealed Tenders, endorsed "Bangor Main Drainage, Contract No. 1," addressed to the undersigned at his office at Bangor, must be received before Twelve Noon on Monday, the 6th day of October, 1930.

The Council does not bind itself to accept the lowest or any Tender.

By Order,
J. MILLIKEN,
Town Clerk.
Town Hall, Bangor, Co. Down, Ireland, 7th August, 1930. 5583

Caterham and Warlingham
URBAN DISTRICT COUNCIL.
MAIN DRAINAGE.

The Urban District Council of Caterham and Warlingham are prepared to receive TENDERS for the CONSTRUCTION, in the Parish of Warlingham, of about 24,100 YARDS of STONEWARE and CAST IRON SEWERS of 7in., 9in., and 12in. in diameter, together with all MANHOLES, VENTILATING SHAFTS and other appurtenant WORKS, in accordance with plans and specification prepared by the Engineers, Messrs. W. H. Radford and Son, Albion Chambers, King-street, Nottingham.

Contractors desirous of tendering may obtain copies of the general conditions of contract, specification, bill of quantities, and form of Tender from the offices of the Engineers upon payment, by cheque only, of the sum of £5 (Five Pounds), which will be returned upon receipt of a bona fide Tender.

The drawings may be inspected at the offices of the Engineers or at the Surveyor's Department, Council Offices, Harestone Valley-road, Caterham.

Sealed Tenders, endorsed "Tender for Warlingham Drainage," must be delivered to the undersigned at the Council Offices, Caterham, not later than Saturday, the 6th day of September, 1930.

The Council do not bind themselves to accept the lowest or any Tender.

By Order,
F. E. DIMMOCK,
Clerk of the Council.
Council Offices, Caterham, Surrey, 11th August, 1930. 5590

TO ENGINE MAKERS.

Tenders are Invited for the SUPPLY and ERECTION of a 90 B.H.P. HEAVY-OIL ENGINE, to comply with B.S.S. No. 213 and other conditions.

Full particulars and Tender form may be obtained on application by letter to DESMOND McATEER, A.R.C.Sc.I., M. Inst. C.E.I., Consulting Engineer, 3, Westmoreland-street, Dublin. 5581

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PUBLIC NOTICES

County Borough of Belfast.

The Improvement Committee invite TENDERS for :—

TWO AIR COMPRESSORS, &c.
ONE HIGH-LIFT SHOVEL.
TWO TRAILERS.
ONE TRACTION ENGINE.
ONE STONEBREAKER.
TWO CONCRETE MIXERS.
ONE CONCRETE BLOCK and SLAB MACHINE.
THREE BITUMEN HEATERS.
TWO ASPHALT HEATERS.
ONE TAR BITUMEN SPRAYER.
150,000 WOOD BLOCKS.
3000 TONS SQUARE SETTS.

Forms of Tender and particulars may be obtained at the office of the City Surveyor, Mr. R. B. Donald, M. Inst. C.E., City Hall.

Sealed Tenders, on forms provided, enclosed in the envelope supplied with the Tender form, endorsed with the name and address of the firm tendering and marked "Tender for ....., Surveyor's Department," to be lodged or posted so as to arrive in the office of the undersigned not later than Monday, 1st September, 1930.

An official receipt must be obtained for every Tender delivered by hand. Tenders sent by post should be registered.

The Corporation do not bind themselves to accept the lowest or any Tender, and the whole or any part of a Tender may be accepted.

R. MEYER,
5603 Town Clerk.

County of London.

The London County Council invites TENDERS for the MANUFACTURE, SUPPLY, DELIVERY and ERECTION of WATER-TUBE BOILERS with STOKERS, SUPERHEATERS, ECONOMISERS, ASH CONVEYING PLANT, AIR HEATERS, GRIT COLLECTORS, FANS, SWITCHGEAR, &c., for Greenwich Power Station.

The specification, form of Tender, &c., may be obtained on application to the General Manager of Tramways, Tramways Offices, 23, Belvedere-road, S.E. 1, upon payment of £3. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn same.

Full particulars of the work may be obtained and the contract document inspected on personal application before payment of the fee.

The contractor will be bound to observe the provisions of a fair wage clause, the terms of which are set out fully in the instructions for Tender and in the form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council, the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 15th September, 1930, will be accepted.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX.
5577 Clerk of the London County Council.

Tyne Improvement Commission

DREDGING PLANT FOR HIRE.

The Tyne Improvement Commissioners are prepared to LET on HIRE for a period to be agreed the following DREDGING PLANT :—

(a) One Centre Ladder Non-propelled Barge Loading Bucket Dredger, bucket capacity 21¼ cubic feet, maximum dredging depth 57ft.; or
One Centre Ladder Non-propelled Barge Loading Bucket Dredger, bucket capacity 20 cubic feet, maximum dredging depth 50ft.
(b) Four Single-screw Steam Hopper Barges, each about 168ft. in length and of a carrying capacity of about 800 tons. Speed, loaded, 9 to 9½ knots.

Particulars of the vessels and terms and conditions of hire may be obtained on application to the undersigned.

By Order,
ALBERT BLACKLOCK,
Secretary.
Tyne Improvement Commission Offices,
Bewick-street, Newcastle-upon-Tyne,
1st August, 1930. 5532

Administrative County of LONDON.

The London County Council invites APPLICATIONS for a HEAD of the GAS ENGINEERING and SUPPLY DEPARTMENT at the Westminster Technical Institute, Vincent-square, S.W. 1.

Candidates should have had workshop experience and possess an Engineering Degree or Diploma.

Salary £580-£25-£725 a year. Further particulars of the appointment will be furnished to applicants.

Apply, Education Officer (T.1), County Hall, S.E. 1 (stamped addressed foolscap envelope necessary) for form, to be returned by 30th September.

Canvassing disqualifies.

MONTAGU H. COX,
5572 Clerk of the London County Council.

Belfast Harbour.

The Belfast Harbour Commissioners invite APPLICATIONS for the POST of ASSISTANT to the RESIDENT ENGINEER on their New Dock Scheme.

Applicants should be University Graduates or with equivalent training, with a knowledge of Survey Work.

This opening presents a good opportunity for a young man fresh from College to gain experience.

The position will be a temporary one, and canvassing the Commissioners will be a disqualification.

Applications, giving full particulars of age, training and experience (if any), and stating salary expected and date when available, must be sent in to the undersigned as early as possible, in any case not later than the 25th August.

M. J. WATKINS,
General Manager and Secretary.
Harbour Office, Belfast,
8th August, 1930. 5574

City of Bradford.

WATERWORKS ENGINEER.

APPLICATIONS are INVITED by the City Council for the APPOINTMENT of WATERWORKS ENGINEER.

Applicants must be members of the Institution of Civil Engineers and must state their age, their experience in designing, constructing, carrying out, and managing waterworks.

Particulars of the duties and conditions appertaining to the appointment will be sent by me on request.

Applications, accompanied by three recent testimonials, and endorsed "Waterworks Engineer," must be delivered to me not later than 10 a.m. on Wednesday, 10th September next.

The appointment will be subject to the Local Government and Other Officers' Superannuation Act, 1922, and to the successful candidate passing satisfactorily a medical examination.

N. L. FLEMING,
Town Clerk.
Town Hall, Bradford,
8th August, 1930. 5584

IRON CASTINGS

BY THE LANZ PERLIT AND THYSSEN EMMEL PROCESSES; HEAT RESISTING PROPERTIES, HIGH TENSILE AND HOMOGENEOUS STRUCTURE.

The Caledon Shipbuilding & Engineering Co., Ltd.,
DUNDEE.

PUBLIC NOTICES

Municipality of Singapore,

STRAITS SETTLEMENTS.
MUNICIPAL ENGINEER'S DEPARTMENT.
ASSISTANT ENGINEER.

The Municipal Commissioners of Singapore REQUIRE an ASSISTANT ENGINEER for the permanent staff of their Municipal Engineer's Department, the appointment being, in the first instance, on a three years' agreement.

Candidates should be between 23 and 28 years of age and unmarried. Applicants must have had a good general education and must have completed a term of pupilship or apprenticeship to a Chartered Civil Engineer. Candidates must have passed the Associate Membership Examination of the Institution of Civil Engineers and should have had two or three years' experience in a Municipal Engineer's office, or on such works as are carried out by a Municipal Engineer. Preference will be given to candidates with Sewerage or Sewage Disposal experience.

Salary 5280 dollars, 5760 dollars and 6240 dollars per annum respectively for the three years of the agreement, rising thereafter (if service be continued) to a maximum of 9600 dollars per annum. The exchange value of the dollar is 2s. 4d. sterling, at which rate the salary for the first year would amount to £616. There is at present no income tax.

Strict medical examination.

Free passage with half salary during the voyage out.

Transport allowance granted.

Liberal Provident Fund.

Eight months' leave, with full pay, is normally granted after four years' service.

Applications, stating whether married or single, and giving age and birthplace with details of education, training and experience, and referring particularly to the qualifications mentioned above and accompanied by copies (not originals) of testimonials, to be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 1, Victoria-street, London, S.W. 1, Agents to the Commissioners, not later than Monday, 25th August, 1930.

Further particulars, if desired, can be obtained from the Agents. 5601

APPOINTMENT OPEN.

The Weaver Navigation

TRUSTEES invite APPLICATIONS for an ASSISTANT and DEPUTY ENGINEER GENERAL MANAGER. Applicants must be Corporate M. Inst. C.E., between 30/40 years of age, and have had experience in directing men and in construction, maintenance and working of docks and inland navigations. Salary £700 per annum, with annual increments of £50 up to £900. Applications must be in writing and state age, education, training, war service, if any, and whether married or single. Two references are required.—Address applications before 30th August to CHAIRMAN, the Finance and Works Committee, Weaver Navigation, Northwich, Ches. 5582

PUBLIC NOTICES

City of Liverpool.

TEMPORARY ENGINEERING DRAUGHTSMAN.

APPLICATIONS are INVITED for a TEMPORARY CIVIL ENGINEERING DRAUGHTSMAN in the City Engineer's Department.

Applicants should be good draughtsmen and have had experience in Railway Work, especially regarding the construction of tunnels and heavy masonry structures. The duties will be to prepare working drawings and to make the necessary calculations.

The salary will be at the rate of £6 per week.

Applications, stating age and qualifications, and accompanied by copies of not more than two recent testimonials, to be forwarded through the post, addressed to the undersigned, endorsed "Engineering Draughtsman," so as to arrive not later than the first post on Friday, the 22nd August.

Canvassing of members of the City Council will be regarded as a disqualification.

WALTER MOON,
Town Clerk.
Municipal Buildings, Liverpool,
11th August, 1930. 5591

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED.—A Fully Qualified and Well-educated MINING ENGINEER for large Colliery Company in India, to commence work as Mine Manager and to qualify for higher promotion.

Age about 30 years. Married preferred. Must be energetic and capable of handling large labour force.

Agreement in first instance for three years, with six months' option on either side.

Salary according to qualifications.

Write, giving age and fullest particulars of experience and positions held to L. B.," c/o Streets, 6, Gracechurch-street, London, E.C. 3. 5600 A

WANTED, for Far East, ENGINEER with Good varied Civil and Constructional experience, possessing an Engineering Degree or Diploma. Must also have some experience of Mechanical Engineering. Applicants must be single and not more than 32 years of age. Agreement for 4 years with free passage out and home and outfit allowance. Good salary and prospects for suitable man.

Full particulars to Box G.B.E., c/o Davies and Co., 95, Bishopsgate, E.C. 2, London. 5570 A

SITUATIONS OPEN (continued)

WANTED, REPRESENTATIVE FOR SCOTLAND.—Old-established Machine Tool Makers REQUIRE Part-time REPRESENTATIVE (resident Glasgow or Edinburgh), with a knowledge of the trade, on commission and expenses basis.
Address, P164, The Engineer Office. P164 A

ASSISTANT ENGINEER. Experienced in Aerial Ropeways. State full particulars of recent experience and salary expected.—Address, 5599, The Engineer Office. 5599 A

INSPECTORS WANTED for London with Experience of Dock and Wharf Construction. Wages £5 10s. 6d. a week, or more if suitable.
Apply, stating age, trade and experience to Box 188, c/o R. Anderson and Co., 14, King William-street, W.C. 2. 5576 A

REINFORCED CONCRETE DESIGNERS (SENIOR) WANTED. Sound theoretical knowledge and experience with specialist firm essential.—Write, stating age, experience and salary required, to INDUSTRIAL CONSTRUCTIONS, Ltd., 54, Victoria-street, S.W. 1. 5571 A

WANTED, First-class DETAILING DRAUGHTSMEN for Structural Steel Work. Must be conversant with L.C.C. Building Acts and capable of Surveying Sites. Good salaries and permanent positions for right men. Give full particulars of age, experience and salary required, &c.—Address, 5598, The Engineer Office. 5598 A

WANTED, LOCOMOTIVE DRAUGHTSMAN, Must be accustomed to all kinds of Arrangement Drawings and not over 30 years of age.—Address, PECKETT and SONS, Ltd., Atlas Locomotive Works, Bristol. 5585 A

WANTED, SENIOR DRAUGHTSMAN, with Knowledge of Constructional Steel Work and Reinforced Concrete. State full experience, age, and salary.—Address, P172, The Engineer Office. P172 A

WANTED, TWO STRUCTURAL DRAUGHTSMEN, Temporary. Must have had experience in Design and Lay-out of Factory Buildings and Garages. State experience and salary required; references.—Address, P162, The Engineer Office. P162 A

For continuation of Small Advertisements see page 4.

Experience not Experiment

MODERN working conditions cannot be satisfied by experimental products, however intensive the work and research on them has been. They can be satisfied only by a finished, tested, perfect job.

It has never been Worthington's policy to market products which are in the experimental stage—it is not fair to the client and it is not fair to the product.

Worthington equipment is the final result of exhaustive experiment, intelligent design and a tradition of sound construction. It is as near perfection as eighty years of engineering experiment can make it.

May our staff of consulting engineers help you over your engineering difficulties? Our experience is entirely at your disposal.

Worthington Horizontal Duplex Stream Line Cargo Oil Pump. For dealing with oils of a specially thick nature. Designed for 200 lbs. working pressure per sq. inch. Fitted with Worthington Patent Streamline Valves. Worthington Type Steam-Ends. Oil-Ends, fitted with packed pistons. Capacity 394-2,000 gallons per minute. Length 6' 3" to 10'.

WORTHINGTON

Telephones: Holborn 4271 (5 lines). *Cables and Telegrams: Pumping, Westcent. London.*

WORTHINGTON - SIMPSON, LIMITED,
QUEEN'S HOUSE, KINGSWAY, LONDON, W.C. 2.
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W.S. 52

A Seven-Day Journal

An Airship Scheme.

SINCE the leading article on the commercial possibilities of the airship, which appears elsewhere in this issue, was written Sir Dennistoun Burney has presented to the Dominion Prime Minister of Canada proposals for the establishment of a bi-weekly Trans-atlantic airship service. The plans submitted by Sir Dennistoun cover the formation of a company with a capital of £6,000,000, backed to the extent of 75 per cent. by the British and Canadian Governments. Four or six airships of a new type, twice the size of R 100, would, it is suggested, be built, one or more of them possibly being constructed in Canada. Each Government would, according to the scheme, enter into contracts for the transport of 6 tons of mail on a bi-weekly service at a charge of £1000 per ton, which would make the airship postal rate between 4d. and 5d. per letter. According to these figures, the revenue anticipated from the transport of mails by the airships would be £12,000 per week, or £600,000 a year, taking fifty weeks to the year. In his recent article in the *Financial Times*, to which we refer in our leader, Sir Dennistoun based his analysis of the commercial possibilities of the airship on a capital of £6,500,000, or substantially the same figure as that which he has submitted to the Canadian Prime Minister. He has now, however, introduced a considerable variation in the estimated receipts. In his newspaper article his gross receipts were taken at £3,800,000 a year from passenger traffic and £2,500,000 from mail fees. The second figure, it will be observed, has been reduced by £1,900,000. It is therefore clear that Sir Dennistoun is no longer considering the possibility of earning a return of about 50 per cent. on the capital.

Conciliation in the Shipbuilding Industry.

THE announcement is made that Mr. T. Graham Robertson, K.C., a leading member of the Scottish Bar, has accepted the joint invitation of the Shipbuilding Employers' Federation and the shipyard trades unions to act as independent chairman at the national general conferences under the conciliation machinery agreements which in 1927 were concluded between the employers and the shipyard trades unions. Mr. Graham Robertson succeeds Lord Macmillan, who was the first holder of the office of independent chairman, but who resigned that position in February last, when he was made a Lord of Appeal. Mr. Robertson took his M.A. and LL.B. degrees with honours at Glasgow University, and was called to the Scottish Bar in 1906, becoming a K.C. in 1922. Throughout his career he has assisted Lord Macmillan and he is in close touch with the work done under the conciliation agreements. During Lord Macmillan's term of chairmanship there was no serious dislocation in the industry, but on several occasions he was called upon to preside at final conferences which were brought about in order to arrive, if possible, at an agreement without a stoppage in the industry. When he resigned all the parties to the conciliation agreement warmly expressed their appreciation of the valuable services he had rendered in promoting peace in the shipbuilding industry during the two years in which he held office. The hope may be expressed that Mr. Robertson's future work will be attended with similar good results.

Naval Items.

IT is reported from Rome that the Argentine cruiser "25 de Mayo," built at the Liguri yard at Leghorn, has exceeded all expectations on her trials. The fuel consumption, so it is said, was 28 per cent. less than what was specified in the contract. The guaranteed speed of 32 knots was exceeded, the speed achieved being 33½ knots in spite of a contrary wind and a maximum draught. The range, intended to be 5000 miles, was found to be over 6000 miles. These figures, it is hardly necessary to say, lack confirmation and should be accepted with caution. Meanwhile the United States Navy, it would appear, is seeking to reduce rather than increase the steaming radius of its ships. The alleged object is to economise expenditure. The estimated saving is said to be £80,000 a year. The Navy Department, with the same object in view, is considering the abolition of the motor cars which American admirals carry on their ships, the closing of Key West naval station, and the scrapping of six cruisers, fourteen submarines and fifty-seven destroyers which are at present out of commission. Another item of naval news published this week concerns the use of aeroplanes on submarines. According to a report from New York, submarines which will carry aeroplanes for scouting purposes are "the latest idea of American naval experts." The Naval General Board is stated to be trying to perfect a miniature catapult for use on destroyers and to have ordered tests to be carried out with collapsible amphibian aeroplanes to be housed on the decks of submarines. Two submarines are to be fitted with water-tight housings on their decks to accommodate an aeroplane with its wings and landing gear folded. This report is difficult to place in its proper surroundings. It has been common knowledge for some time that both the British and the United States navies already possess submarines carrying or capable of carrying aircraft. As for the aeroplanes produced for the purpose, there is no secret concerning their design. An example of a small folding two-seater submarine aeroplane was shown at last year's Aeronautical Exhibition at Olympia and was illustrated and described in our issue of July 19th, 1929.

Harland and Wolff, Ltd.

LORD KYLSANT, having intimated his wish to retire from the chairmanship of Harland and Wolff, Ltd., the board has unanimously appointed Mr. F. E. Rebbeck, one of the joint managing directors, to be chairman of the board. During the last ten years Mr. Rebbeck has had sole charge of the engineering work at Queen's Island, and has been responsible for the design and construction of the machinery for many important steamships and motor vessels. He came to Belfast about thirty years ago in order to take up a position with a local engineering firm, but soon transferred his services to Harland and Wolff, Ltd. After serving in the drawing-office he spent some time at the works of the then Westinghouse Company at Trafford Park, Manchester, and subsequently returned to Belfast, where his work soon attracted the attention of the late Lord Pirrie. At the Glasgow works of Harland and Wolff he studied the application of the Diesel engine to marine propulsion, and worked closely in conjunction with Burmeister and Wain, of Copenhagen, in the development of the Harland-B. and W. type of engine. During the war period Mr. Rebbeck was in charge of the Glasgow works, but about eleven years ago he returned to Belfast to succeed the late Mr. George Cumming as head of the Belfast engineering department. Although a convinced believer in the future of the motor vessel, Mr. Rebbeck has not overlooked the remarkable advances made in marine steam turbine practice, and the engining of the Holland-America liner "Statendam" with high-pressure turbine machinery is a work of which he is justly proud. As an example of his firm's oil engine practice we need only refer to the series of large motor passenger liners which Harland and Wolff have constructed for the Royal Mail and Union-Castle Lines, the Nelson Line, and the White Star Line. Mr. Rebbeck has been called upon to take high office at a time of recognised difficulty in the shipbuilding and marine engineering industry, and we wish him great success in maintaining the high prestige which his firm has gained for ships of every kind.

The Air Manœuvres.

THIS year's Royal Air Force exercises, which began on Tuesday and which are to be completed by to-morrow, are less realistic than those of former years, in which the attack and defence of London were the main objects. For the manœuvres now in progress Britain is supposed to be an island divided into two small states, which are colonies of two countries, Redland and Blueland. The Red colony lies to the North and East with its capital at Cranwell, and the Blue colony to the South and West with its capital at Salisbury. The Air Officer commanding the Blue Colony forces is concentrating upon preventing the mineral output of the Red Colony mines from reaching the parent country, Redland, and assisting that country's production of munitions. The Red Colony commander has to protect the mines and the railway, canal and port by which the mineral products are shipped to Redland. The manœuvres, therefore, take the form largely of bombing raids on the part of the Blue Colony forces and a fighting defence on the part of the Red Colony forces. They are designed to simulate the strategic defensive conditions likely to exist in an overseas campaign. The unreality of the operations is enhanced by the imaginary existence of a range of vast mountains stretching from the south of Lancashire to the south of London and curving up northwards to Norfolk. This range marks the frontier and can only be crossed at one or other of five imaginary passes. Altogether about 250 machines—five night bomber squadrons, nine day bomber squadrons and eleven fighter squadrons—are taking part in the exercises.

An Important Report on Unemployment.

SOME time ago the Association of British Chambers of Commerce sought the views on the causes of and remedies for unemployment of over a hundred Chambers of Commerce in different parts of the country. A report based on the views so collected has now been issued by the Association and has been presented to the Government. The report displays no great enthusiasm for rationalisation, which, it holds, is in any event not sufficient by itself to restore general prosperity. Expenditure on emergency relief schemes, unless in very exceptional circumstances, is strongly opposed on the ground that it will on balance do more harm than good. The general tenour of the report is an insistence on the effect which the payment of high wages in the sheltered occupations, such as transport, public utility services, and the distributing and retail trades, has upon the wages of those employed in unsheltered occupations. The standard of wages in the sheltered industries, it is maintained, keeps the cost of living high, raises the cost of production in the unsheltered trades, and contributes to loss of trade and unemployment. The Association urges the Government to request the Economic Advisory Council to investigate this subject and to devise some method whereby wages in the sheltered occupations should be brought into fair relationship to the wages in the unsheltered industries. Among other recommendations made by the Association are the extension of safeguarding, the development of Empire trade, the reduction of transport and dock charges, the institution of a truce from all new legislation imposing fresh regulations and laws which add to the cost of production, and the abolition of such trade union restrictions as act in the same direction.

A Year's Boiler Explosions.

THE report issued this week by the Board of Trade upon the working of the Boiler Explosions Acts during 1929 shows that the number of explosions dealt with by the Board, namely, 88, was greater than in any year since the war and was in excess of the average number, 65·2, dealt with each year since 1882. The explosions were, however, mild in the infliction of fatal injuries, only 9 lives being lost by those which occurred during 1929, as compared with the average figure of 22·3 during the past forty-eight years. Only twice since the war have the fatalities been as few or smaller. On the other hand, the number of non-fatal injuries resulting from last year's explosions, namely, 57, was above the average, 53·7, for the years since 1882, and has been exceeded only twice since the war. The nine deaths which occurred last year were caused by six explosions, five on land and one in a ship. One explosion, involving the death of two persons and injuries to seven others, was made the subject of a formal investigation. The insurance association concerned, its chief engineer, and an engineer were held to blame and were ordered to pay £400, £150, and £50 respectively towards the costs of the investigation. The ages of the "boilers" which exploded covered a wide range, the eldest, a steam-jacketed pan, being given as at least fifty-two years.

L.N.E. Railway New Rolling Stock.

ON Tuesday last, August 12th, new rolling stock was used for the first time on the London and North-Eastern Railway Company's express train "The Highlandman" between London and Inverness. Of special interest were the two new sleeping-cars, which have been designed by Mr. Gresley, the Chief Mechanical Engineer. Each car has ten rooms arranged in pairs, which, if desired, can be converted into five double rooms by communicating doors. For the first time full-sized beds instead of berths have been provided, and a very neat arrangement of electric lighting is employed. Another novel feature is the use of adjustable nozzle ventilators, similar to those now so extensively used aboard ship. Provision is made for the control of the direction, the volume, and the temperature of the entering air, and all the heating, lighting, and ventilating controls are conveniently worked from the head of the bed. An electric generator placed below each car serves to provide the current required for lighting, heating, and ventilating purposes. The new passenger compartments, which have been built as the result of prizes offered by the railway company in connection with the Industrial Designs Competition of the Royal Society of Arts, include a first-class and third-class compartment, which embody some improvements as regards colour, seating arrangements, electrical fittings, and luggage racks. The judges of the competition awarded two prizes, but they reported that several competitors did not show great originality or inventive talent in their designs.

The German Locomotive Industry.

A SIDELIGHT on the present conditions of the German locomotive industry, additional to that given in a recent paragraph, is provided by the news received this week from Frankfort concerning the complaints of the builders against the activities of the Schickauwerke at Elbing, East Prussia. Some time ago the Schickau firm was faced with difficulties which threatened its extinction. The Government of the Reich, deeming it desirable to maintain an important engineering establishment in the Dantzig district, came to the rescue with a considerable subsidy. The establishment continued to produce small craft, and in addition took up the manufacture of locomotives and general engineering work. It is to-day continuing with the aid of the Government subsidy and would seem in effect, if not in name, to be a Government establishment. It recently secured an order from the Indian State Railways for, it is understood, boilers, at a remarkably low price, a price so low that, according to the other German manufacturers of locomotives, it could not have been quoted had the firm not had Government support. The rival establishments addressed a protest on the subject to the Ministry of Labour. The reply received was considered unsatisfactory, and they now desire that an impartial commission should be appointed to inquire into the question. The Ministry has approved of the formation of such a commission, and it is probable that it will very soon be set up.

The Protection of Alternating Current Generators.

No. II.*

As shown in the previous article, in order to protect 85 per cent. of the windings of a generator employing relays set at 15 per cent., the earthing resistance must be arranged to pass a current equal to the full load current of the machine. When the earth current is less than the full load, the percentage of the winding protected against earth faults is proportionally less with the same relay setting. Other things being equal, the effect of reducing the setting is adversely to affect the "stability ratio" or the ratio of the maximum through fault current at which the relay remains inoperative to the minimum fault setting. The Metropolitan-Vickers Electrical Company has, however, devised and patented a modification of the circulating current system, whereby the setting for earth faults only is reduced without impairing the "stability ratio." The modifications, which only affect the relay connections, consist in connecting two relays or two poles of a three-pole relay to be operative in the case of phase

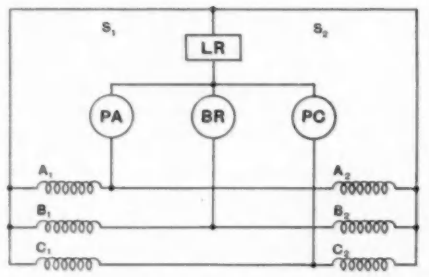


FIG. 5—MODIFIED CONNECTIONS FOR 3-POLE RELAY

faults, and the third relay to operate only in the event of faults to earth, which are, of course, limited in magnitude by the earthing resistance. Thus, the earth fault relay is not subjected to the effects of heavy through fault currents as are the phase fault relays, and must be set lower than the latter. The connections, which are shown in Fig. 5 and 6, differ from the standard system in the position of the central relay L R, which is replaced in its normal position by a balancing resistance B R, and itself inserted in the common connection of the two relays P A and P C and the balancing resistance B R to the neutral pilot wire. Thus any out-of-balance current in the protective system, due to an earth fault on one phase, must pass through the relay L R, *vid* the pilot S_1 or S_2 to the neutral of the current transformers, whilst out-of-balance current, due to faults between phases, will circulate round two transformer secondaries, *vid* any two of the three coils P A, B R, P C (the pair

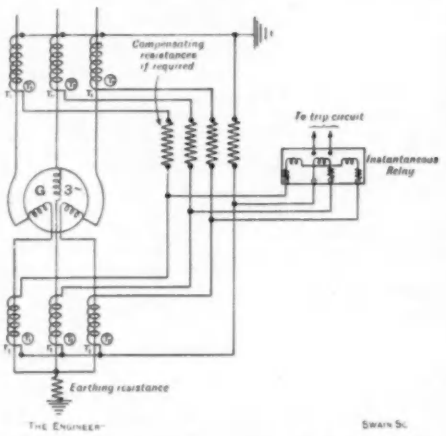


FIG. 6—MODIFIED SYSTEM OF 3-PHASE GENERATOR PROTECTION

depending on which two phases are shorted), without passing through L R. If phase A 1, A 2, for instance, supplies fault current to an earth fault external to the machine, the currents in S_1 and S_2 are equal and the ends of L R and P A in series are at equi-potential points. Similarly, any out of balance that may be produced in the two groups of transformers A_1, B_1, C_1 and A_2, B_2, C_3, by a phase fault external to the generator, tends to be equal in the two groups and will consequently sum up to circulate round S_1 and S_2, again without passing through L R.

Thus it is clear that, owing to the restricted earth fault current, the modified relay connections result in a sufficiently wide margin over and above the "stability ratio," obtained with the standard connections to enable the setting of the earth fault relay to be reduced substantially and at the same time to obtain adequate stability. The percentage of the generator windings protected is thus brought nearer to the value 85 per cent. obtained with the standard connections, although it will be understood that the actual value depends on the earthing resistance used. The curves, Fig. 7, show the variation of fault setting with the ohmic value of the earthing resistance using (*a*) the standard connections and (*b*) the modified connections.

In view of the decreased settings obtainable with the modified arrangement, the question arises as to why the latter is not used universally to the exclusion of the original scheme; but it should be remembered that, in reducing the relay setting, advantage is taken of the limited through fault current to earth, and where the earth current is not so limited the out-of-balance, or through faults, to earth must be considered. Moreover, the low setting of the earth relay is assisted and made possible by the fact that it is connected in such a way that stability on heavy through faults is dependent only on good balance between separate pairs of transformers. If A 1 and A 2 in Fig. 5 are in perfect balance, no current will pass through L R, and, similarly, with B 1, B 2 and C 1 and C 2. On the other hand, lack of balance between each transformer and any of the other five will produce current either in P A or P C, or in both, and as perfect balance between any combination of pairs is more difficult to achieve than between separate pairs, it follows that P A and P C may not be set as low as L R for the same "stability ratio." When the earth fault current is not limited to a value substantially less than full load, it is not permissible to connect the earth relay as in the modified scheme. Consequently, both phase and earth fault relays are affected by out-of-balance between any combination of pairs, and must therefore be set equally and at the higher value of 0·5 ampère. In any case, there is little to be gained by reducing settings when the earthing resistance passes full load, or more, whether the reduction is accompanied by altered conditions or not, as under these conditions the insulation stresses on the unprotected portion of the winding are so small that the possibility of breakdown is negligible.

With the earlier forms of the circulating current

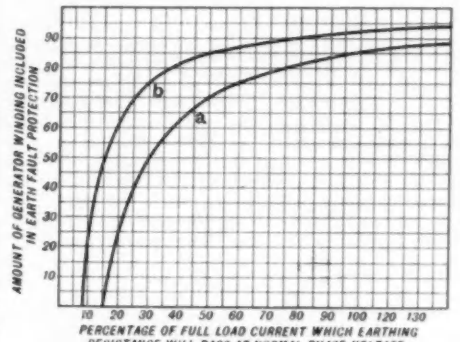


FIG. 7—GENERATOR PROTECTION CURVES

system, the minimum fault settings obtained were considerably higher than those achieved to-day, improvements in relays being mainly responsible for the greatly reduced settings. In an effort to meet the need of lower settings for generator protection, the self-balancing system was evolved and, at the time, it proved much superior in this respect to the earlier system. But, since then, settings low enough to meet all ordinary requirements have been made possible with the circulating current system. Taken in conjunction with some minor disadvantages peculiar to the self-balancing system in connection with switchgear, that fact has restricted its usefulness, with the result that the circulating current system has held first place. Nevertheless, for cases in which a setting lower than the 15 per cent. obtainable with the last-mentioned system is desired, the self-balancing system still remains an ideal one, affording as it does settings as low as 5 per cent. coupled with perfect stability.

The basic principle is similar to that of the circulating current system, viz., that equality between the entering and leaving currents is disturbed on the occurrence of a fault within the apparatus. The currents entering and leaving each phase of the machine windings are passed in opposite directions through the same ring transformer—Fig. 8—the secondary winding of which is connected to a relay. The conditions for balance are thus good, and even with the largest current conceivable there is no tendency to magnetise the core. But, on the occurrence of a fault, the equality of the currents is disturbed and a flux proportional to the difference is induced in the core, thereby energising the secondary and operating the relay. The difference current necessary for operation for a transformer of a given size is determined entirely by the sensitiveness of the relay, as no allowance is required for transformer unbalance. The fault setting is, moreover, almost independent of the size of the machine—the same value of fault current is required for the operation in the case of a 500-kilowatt machine as a 10,000-kilowatt one. Since the average value, using relays of average sensitiveness—the Metropolitan-Vickers type "F" relay is about 20 ampères—it follows that there is little to be gained by employing self-balancing gear on machines up to about 2000-kilowatts at 6600 volts unless super-sensitive relays such as that company's "F B" type relays are used. With machines of 500 kilowatts capacity or less, the setting, even when "F B" type relays are employed, is higher than that obtained with circulating current gear, but for larger machines than the 2000-kilowatt size, the advantage of the latter system from the fault setting point of view is considerable.* A fault setting of 20 ampères with a 10,000-kilowatt, 6600-volt machine, for example, represents only 2 per cent. of the full load current, thus, given that the generator earthing resistance limits the earth fault current to a value equivalent to full load current, 98 per cent. of the windings are included within the earth fault protection, or, viewed from another point of view,

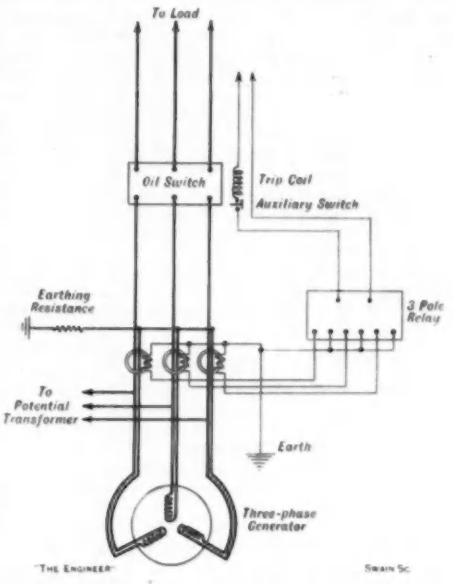


FIG. 8—SELF-BALANCING PROTECTIVE SYSTEM

a cheaper earthing resistance to pass a smaller current could be used at the expense of a slight reduction in the percentage of the winding protected. A resistance designed to limit the current to half the previous figure, for example, would involve a reduction in the protected area of only 2 per cent., *i.e.*, from 98 to 96 per cent.

The same remarks apply to low-voltage small-capacity machines as to high-voltage, large-capacity machines; but, since it is the usual practice to connect the neutral points of low-voltage alternators directly to earth without intervening resistance, there is no point in providing ultra-sensitive protective equipment. The circulating current system will provide adequate protection over practically the whole of the windings.

One of the disadvantages of the self-balancing system, and one which cannot be easily overcome, is the necessity for passing both ends of each phase winding in close proximity through the same trans-

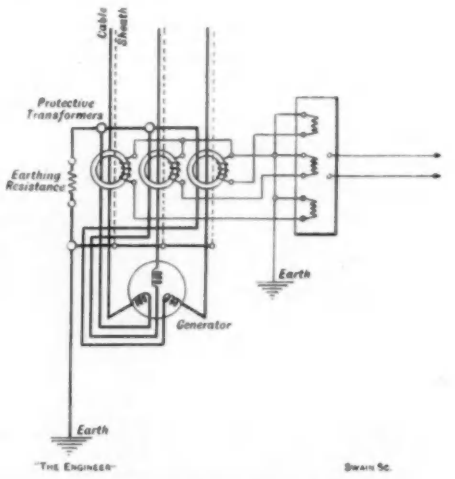


FIG. 9—SELF-BALANCING PROTECTIVE GEAR FOR GENERATOR AND CABLES

former. Another disadvantage is the difficulty of including within the protected area the leads between the generator terminals and the switchgear. The protective current transformers must, of necessity, be near the machine to avoid long lengths of cable between the windings and star point connections, and that automatically confines the protection to the machine, faults on the connecting cables being ineffective as regards operating the gear. But this difficulty can be got over by the use of a special cable incorporating a continuous copper conducting sheath wound round, but insulated from, the main core and also from the lead covering. The cable glands at the machine and at the switchgear should also be lightly

* No. I. appeared August 8th.

insulated from the sealing ends, which are normally earthed. The sheath is earthed to the sealing ends at the generator after passing through the self-balancing transformer, but is left insulated at the switchgear, and with this arrangement an earth fault on the cable always involves the sheath, which affords a good conducting path for the fault current to earth *viâ* the transformer, wherein it sets up the requisite unbalance for the operation of the relay. The risk of short circuits in the cables can be minimised by using three separate single-core cables, but, in the event of such a fault, it is inconceivable that the sheaths will not be energised so that operation of the protective gear is assured. When three-core cable is used the same, of course, applies, and in this case the risk of a short circuit is probably somewhat greater. A diagram of connections for the system embodying the special cable, is shown in Fig. 9.

Where the transmission of power at ordinary generator voltages is uneconomical owing to the generating station being a considerable distance from the load centre, it is common practice to connect the generators directly to step-up transformers without intervening low-tension switchgear, each generator and transformer forming a high-voltage unit capable of being switched on to high-voltage bus-bars. Here again, the most satisfactory method of protection is the circulating current system, but with modified relay settings and connections, the reason for the modifications being that, in the case of the combined unit, the effect of the transformer magnetising current, which constitutes a definite out of balance in the protective system, must be taken into account. The result of lack of balance between the currents in the transformers in corresponding phases is to pass a current through the relay coil. For ideal conditions any initial unwanted out of balance should be eliminated. In the case of simple generator protection such currents, if they exist at all, only amount to a few milliampères at full load and are due to slight differences in the current transformer characteristics. But the inclusion of a power transformer within the protected zone introduces an unbalance owing to the magnetising current which only appears in one set of current transformers, viz., those connected in the generator windings at the neutral point. The out-of-balance current must obviously pass through the relays, and unless the setting is made to correspond to an out-of-balance current higher than that caused by the maximum possible magnetising current, it will result in untimely operation. Although the steady value of the magnetising current of a power transformer is only a small percentage of the normal full load during the moment of switching the transformer on to the supply, its value may be very much higher, and this higher value, which may reach the full-load current, must be taken into account when considering the setting for circulating current protective relays.

The absence of switchgear between the generator and the transformer may lead to the supposition that sudden applications of voltage are not experienced, but it must be remembered that a rapid and violent change in load owing, say, to a network short circuit, will cause a severe fall in the generator voltage and the resulting rise upon the sudden restoration of normal conditions is comparable with the effect of switching a transformer on to the supply, whilst a similar effect is experienced with a sudden reduction in the load carried by the generator. In both cases the transformer may draw considerable magnetising current, and, if the relays were not set well out of the range of such contingencies, the corrresponding unbalance would cut off the unit. The setting must, therefore, be much higher than that employed for ordinary generator protection. As already shown, however, an increase in the relay setting results in a reduction in the amount of the generator winding protected against earth faults, and, if the same degree of protection is to be obtained as with the lower setting, a modification of the scheme is necessary.

The scheme recommended by the Metropolitan-Vickers Electrical Company introduces an additional earth leakage relay to operate only when an earth fault occurs on the generator or the primary winding of the step-up transformer, phase-to-phase faults on the entire unit being taken care of by the circulating current system. From the diagram Fig. 10, which shows the scheme applied to a combined unit, it will be perceived that the generator windings, together with the primary windings of the step-up transformer, form a local circuit having no electrical connection with the transformer secondary winding or any apparatus connected to it. When the neutral point is earthed as shown, current will pass in the earth connection only in the event of an earth fault in the local circuit. A relay interposed in the earth connection is, therefore, only energised by faults on the generator and transformer windings, and is, moreover, unaffected by the transformer magnetising current. A convenient method of interposing the relay in the generator earth connection is to connect it across the secondary winding of a voltage transformer, the primary of which is in series with the earth connection. The "F" type relay is set to operate at a secondary voltage corresponding to, say, 10 per cent. of normal phase voltage on the primary of the voltage transformer, that being effective to protect 90 per cent. of the machine windings and of the step-up transformer windings if star connected, whilst mesh-connected transformers are completely protected with a setting of 40 or 50 per cent. The voltage transformer limits the maximum current which can pass to earth on the occurrence of a fault to a value equivalent to its magnetising current, and as the strictly limited earth current effectively obviates the risk of damage to the machine owing to earth faults, that is an advantage. Although the conditions are practically analogous to running with an unearthed or insulated neutral, there can be no objections on this score, as the main reason for earthing a system is to prevent undue potential stresses on the transmission lines or cables, which, in the case under consideration, are not, of course, directly connected to the earthed generator. It has been suggested, however, that the earthing of a generator in this way is liable to increase the risk of damage to a machine by lightning, as the voltage transformer primary winding offers considerable reactance to the passage of high-frequency discharges, causing the potential stress to build up on the machine side of the transformer and machine windings. Such discharges are, of course, static in character and are only transmitted to the machine through the electrostatic capacity between the high and low-tension windings of the step-up transformer. By connecting an ordinary high-tension fuse and limiting resistance across the voltage transformer primary winding, lightning discharges are drained away to earth *viâ* the fuse, and, on the passage of a fault current to earth, the fuse is immediately ruptured, thus inserting the voltage transformer and energising the earth fault relay, which may be arranged either to trip the faulty machine by opening both the main

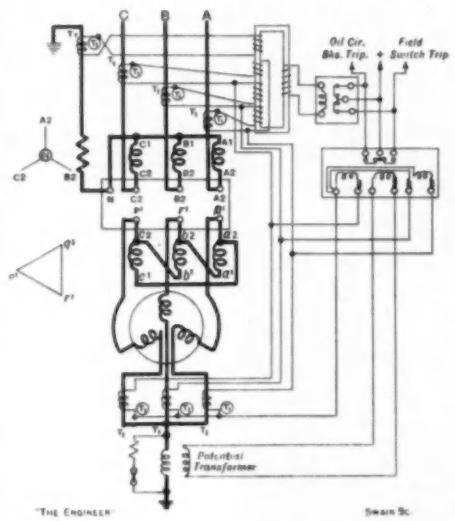


FIG. 10—PROTECTIVE SYSTEM FOR GENERATOR AND TRANSFORMER

oil switch and the generator field switch or merely to ring an alarm bell to call attention to the existence of an earth on the machine or transformer, in which case the machine is maintained in service until such time as it may be found convenient to take it off load. Meantime the fault current to earth is limited to an insignificant value by the voltage transformer so that no harm is done to the unit.

As phase to phase faults are never limited by any resistance other than the inherent circuit resistance, they always produce a substantial out-of-balance current, even when the fault is in the neighbourhood of the neutral point, and a setting of two ampères for the two relays required gives adequate protection against phase-to-phase faults as well as stability on through faults. Another way in which the protective gear for a combined generator and transformer unit differs from that of a generator is the necessity in the former case for the current transformers in the machine windings to differ in ratio from those in the secondary circuit of the transformer, the exact difference being determined by the ratio of the step-up transformers and by the method of connecting the windings. The usual practice is to connect the step-up transformer primary windings in delta and the secondary windings in star, and that results in a phase displacement of 30 deg. between the currents entering the primary windings and those leaving the secondary terminals. Thus, there is a corresponding displacement between the secondary currents in the two sets of protective transformers, and, as similarity of phase is an essential condition for balance, this displacement must be corrected by connecting the secondary windings of those in the machine windings in star and those on the star-connected side of the transformer in delta. In order that the current delivered to the pilot wires shall have the same value for both the star and delta-connected protective transformers, the latter are wound for a secondary current equal to 57·8 per cent. of the former; that is to say, if the current transformers having secondaries wound for a full load current of 5 ampères are used in the machine windings, those in the transformer circuit must be wound for a full load secondary current of 2·8 ampères, *i.e.*, 5/1·73.

If a setting more sensitive than the 40 per cent. obtainable with the equipment described is desired for earth leakage faults on the high-voltage side of the step-up transformer, an additional single-pole relay is necessary, and Fig. 10 shows the connections for the complete protective equipment, including the sensitive high-voltage leakage protection with which a fault setting of about 15 per cent. of normal full load can be obtained. The high-voltage leakage relay is connected to the single secondary winding of a small multi-primary transformer, the primary windings being connected in series with each of the three high-voltage circulating current protective transformer secondaries and one to the secondary of a current transformer in the neutral connection to earth. This latter winding is connected in opposition to the other three and is only energised when an earth fault occurs on the main transformer high-voltage windings, or on the high-voltage network. In the latter case equal and opposite currents flow in two of the windings, and, as no E.M.F. is induced in the secondary, the relay remains inoperative. When the fault is on the transformer windings, no fault current appears in the high-voltage current transformers and only the winding connected to the neutral current transformer is energised, and, as a result, the necessary E.M.F. is induced in the secondary to operate the relay, thereby tripping the machine and transformer unit.

A matter that is sometimes overlooked is that the inherent simplicity of any system can be entirely nullified by the use of complicated relays or relays embodying weak points in the design or construction, and to this matter the Metropolitan-Vickers Electrical Company has paid special attention. The nature of the system under consideration admits of the use of the simplest form of electromagnetic relay with a minimum number of parts. In the case of the circulating current system, sensitiveness is a secondary consideration, as a high relay impedance, and consequently an increased power consumption, are advantageous. The advantages of the self-balancing system are, however, lost unless the relay is reasonably and, in some cases, extremely sensitive. Relays carefully designed for and adapted to the different needs of the two systems are represented by the Metropolitan-Vickers type "F" and "F B" instantaneous relays. The former may be used with either system, but the latter is intended for use with self-balancing gear.

The need for rapidly isolating and "killing" the field of a faulty machine is shown by the fact that stators have been seriously damaged in 10 seconds. Even when a machine is equipped with anti-fire devices, the extent of the damage, if the fire is allowed to start, is enormous as compared with the damage if prompt isolation and suppression of the field have prevented a fire. The time required for an oil switch to complete the opening of the circuit varies slightly with different types and sizes of switches, an average figure being about 0·25 second, but even this comparatively short period may be too long to prevent a certain amount of burning in the case of heavy faults. It is, therefore, essential that the time taken for the relay contacts to close after the coil has been energised should be as short as possible, and that, when once closed, they should remain in permanent contact without chattering until the circuit is cleared by the opening of the switches necessary for the isolation of the machine. The "F" type relays are, accordingly, designed to operate in less than one-fiftieth of a second, and an auxiliary "make sure" contact reinforces the main relay contacts and renders operation of the relay independent of the main contacts, thereby eliminating chattering and making sure of decisive operation. The auxiliary contact may either take the form of a mechanically-released drop switch, which acts as an indicator, or a small electrically-operated contactor switch, energised by the trip coil current upon the completion of the tripping circuit by the main relay contacts, and this type embodies a drop indicator to give visual indication of the operation of a particular relay or relay element. In both instances the indicator, which, in the case of mechanical type is also the auxiliary contact, is re-set by hand. Some form of indicator is essential, especially where apparatus is under the control of more than one relay; in any case, it is always useful to know on which phase or phases the fault has developed. The type "F" relay is arranged with double-trip contacts, so that the tripping circuits for the generator oil switch and the field switch can be kept separate, and that, by avoiding the necessity for paralleling the trip coils, facilitates individual control of the two switches. In the case of the "F B" relay, the drop-switch type of auxiliary contacts is not suitable and the contactor-switch type with an indicator is fitted as standard.

(To be continued.)

A COMMERCIAL mission is to be sent by the Government to the Far East, its terms of reference being "to inquire into the present condition of British trade with China and Japan, and to report what action should be taken to develop and increase that trade." The members of the mission are: Sir Ernest Thompson, J.P., Sir Thomas Allen, Mr. James Bell, J.P., Mr. William A. Crowther, J.P., Lieut.-Colonel Reginald Morcom (Messrs. Belliss and Morcom), and Mr. Louis Beale. The secretary is Mr. T. St. Quinton Hill.

The Canadian Pacific Liner "Empress of Japan."

No. I.

The twin-screw geared turbine passenger liner "Empress of Japan," which has been built by the Fairfield Shipbuilding and Engineering Company, Ltd., of Govan, Glasgow, for the Trans-Pacific service of the Canadian Pacific Railway Company, is the largest ship yet added to that company's fleet. After undergoing successful trials on the Clyde, the new liner made voyages to Canada and back and has now arrived in the East *vid* the Suez Canal route, to take up her regular Pacific service between Vancouver and Hong Kong. She was designed by the Fairfield Company to meet her owner's special requirements according to arrangement plans supplied by the technical staff of Canadian Pacific Steamships, Ltd., and her construction was supervised by Messrs. C. S. Douglas and Co., consulting naval architects, of Glasgow.

The principal particulars of the vessel, views of which are reproduced on page 174, are as follows :—

Hull Particulars.

Length overall	666ft.
Breadth at promenade deck	87ft. 9in.
Depth moulded to bridge deck	56ft. 9in.
Designed trial speed	23 knots
Designed service speed	21 knots
Gross tonnage	26,032

Passenger Accommodation.

First-class passengers	399
Second-class passengers	164
Third-class passengers	100
Asiatic steerage passengers	510
Officers and crew	579
Total ship's complement	1752 persons

Cargo Accommodation.

Deadweight carrying capacity	10,200 tons
Cargo holds and 'tween deck cargo spaces, total	304,000 cubic feet
Space for silk included in above	59,000 cubic feet
Space for insulated cargo included in above	33,000 cubic feet

The "Empress of Japan" has been built under special survey to Lloyd's highest class and she is subdivided in full accordance with the Bulkhead Convention requirements. She fulfils in her design all the requirements of the International Conference on Safety of Life at Sea, as well as the rules of the British Board of Trade, the Home Office, Factory Acts, and the Canadian and American laws for high-class passenger liners.

A prominent feature of the ship—see the upper view on page 174—is her three raked funnels, which, together with her two pole masts, her well-balanced superstructure and graceful lines, give her a handsome appearance. She has a straight stem, and, as shown in Fig. 1, her stern is of the modified cruiser form, combined with a rudder of streamline section, so arranged that the main part of the hull ends on the face of the rudder, giving a good streamline effect. The two propellers, which, we are given to understand, are the largest solid-form bladed propellers yet constructed, were supplied by J. Stone and Co., Ltd., of Deptford, and were cast and machined at the firm's Charlton foundry. The casting weight of each propeller was 35 tons and the finished weight 21 tons, the diameter being over 20ft. Before settling the final design of the propellers, experiments were carried out at the National William Froude Tank, these experiments including tests on the hull and appendages. As will be seen from the 'midship section reproduced in Fig. 2, there are seven decks, excluding the orlop deck, and also the navigating bridges, which are arranged at the forward end of the sun deck and are clearly shown in the broadside view on page 174. The total height of the ship from the keel to the top of the wheel-house is 107ft. Although the hull of the ship conforms to Lloyd's +100 A1 Survey, the structure embodies many features which are in excess of classification requirements. They include special keel plating, double bottom framing, deck scantlings and additional thickness of shell plating, also extra anchor and cable equipment.

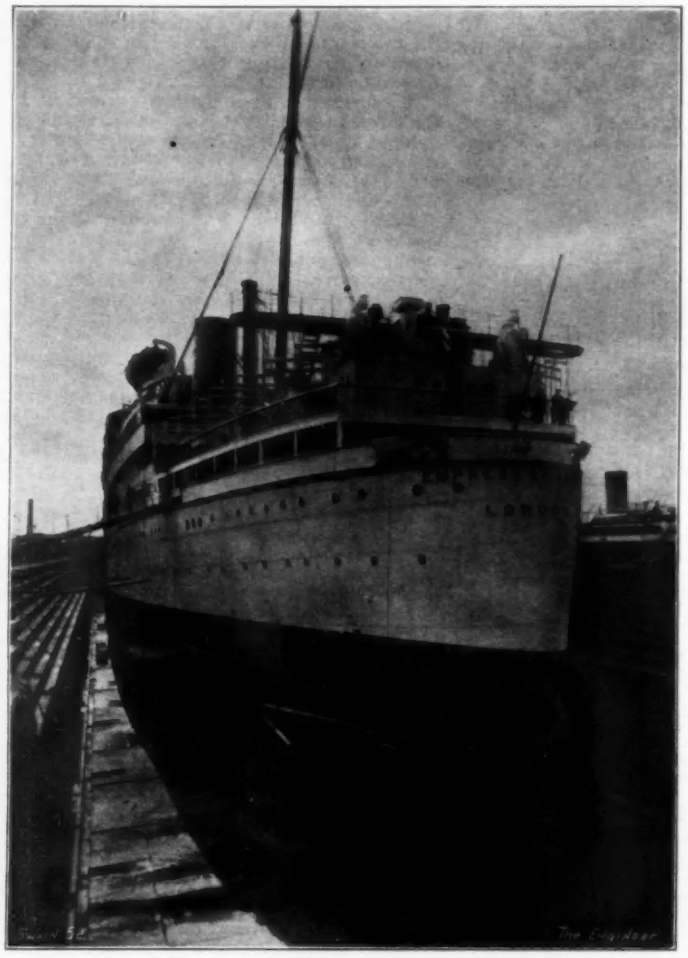


FIG. 1—STERN VIEW SHOWING PROPELLERS AND RUDDER

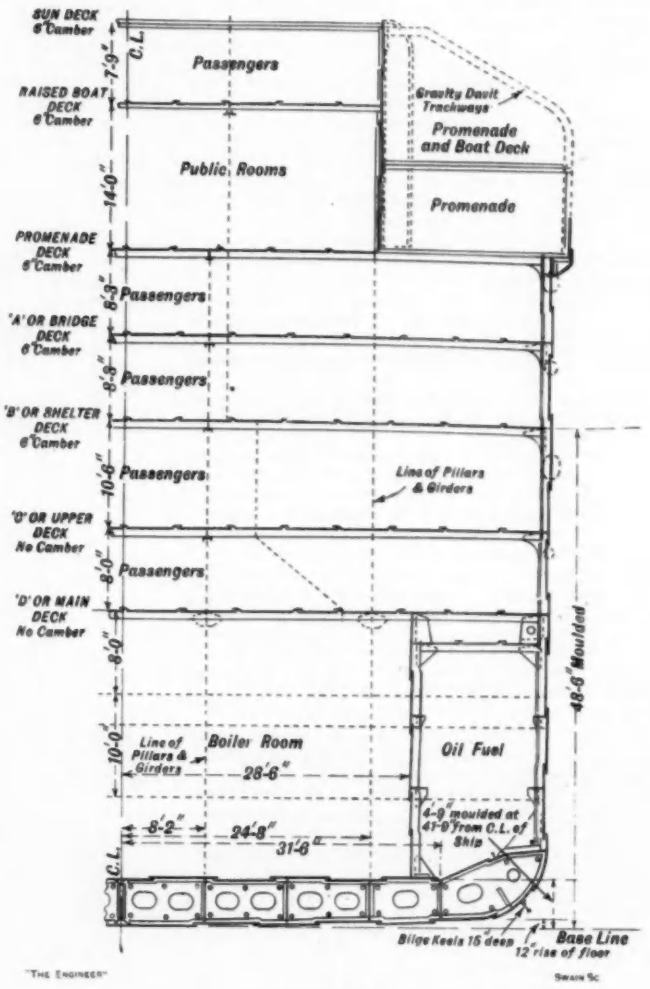


FIG. 2—HALF 'MIDSHIP SECTION

The double bottom is carried right fore and aft and is arranged with tanks for fresh water or water ballast and oil fuel or water ballast. For the purpose of trimming, either fresh water or water ballast is carried in the fore and after peak tanks, while large fresh water tanks and oil fuel tanks are built into the hull at the side of the turbine and boiler rooms and the shaft tunnels. The middle portion of the ship below the main deck, which is the lowest continuous deck, is occupied by the turbine room, the two boiler rooms, the auxiliary oil engine generator room, and the fuel and water tanks above referred to. The main transverse bulkheads are carried to the upper deck and they are ten in number. In these bulkheads there are fitted no less than twenty-one vertical sliding water-tight doors, all of which are operated on the Brunton hydraulic system, which permits all doors to be closed simultaneously from the bridge or operated separately from either side of the bulkheads. In addition to power operation, hand gear is fitted, and there are the usual automatic indicators showing whether the doors are in the open or closed position.

In all, twenty-six special Board of Trade lifeboats, which include two motor boats fitted with wireless equipment, are carried, the boat capacity being sufficient for the full complement of passengers and crew. The boats are stowed on the boat deck under davits of the Welin-MacLachlan patented gravity type. As will be seen in the two lower views on page 174, the boat winches are arranged overhead on the sun deck level, which gives a clear fore-and-aft promenade on the boat deck itself.

Starting from the top of the ship it may be noted in passing that on the sun deck there are houses arranged for the service tanks and fire-extinguishing apparatus, also the thermo tank ventilating installation and the ventilating fans. Over the public rooms there are large domed skylights, giving light below, and also ventilating cowls and air passages. A feature of this deck is the large open space, which may be used as a sports or games deck and which is illustrated in Fig. 3. At the forward end of this deck is the navigating bridge, with accommodation for the captain and pilots and with the wheel house and chart room above. The navigational instruments include a gyroscopic compass equipment, by the Sperry Gyroscope Company, Ltd., which comprises a Mark VIII. master compass with a steering repeater, a bearing repeater and chart house repeater, also a fully automatic course recorder and gyro-repeater attachment to the Marconi direction finder. Other Sperry equipment includes 18in. high intensity searchlights of the naval type with a beam candle-power of about thirty millions. Other navigating equipment includes "Echo" sounding gear, submerged log apparatus, while in the chart room there is also housed the Lux-Rich fire detection and extinguishing plant and the master electric clock which controls all clocks throughout the ship. A very complete Marconi wireless equipment is fitted with special wireless offices. On the bridge itself, which is furnished with a screen shelter with large windows at each side, there are the telegraphs to the engine-room, the steering, docking, and lookout points, while Graham's "Multi-phones" are fitted between the bridge and the docking bridge, also the crow's nest and lookout positions at the bow and the boat stations. Between the bridge and the wireless telegraph office, also the gyro-compass room, the chief engineer's room, the steering compartment and the docking wheel house aft Graham's loud-sounding telephones are installed. The steering gear, which is housed in a special compartment aft, is of the hydraulic-electric type and was supplied by Brown Bros. and Co., Ltd., of Edinburgh. The same firm made the telemotor gear to the navigating bridge and the mechanical controls beneath the docking bridge.

PASSENGER ACCOMMODATION AND PUBLIC ROOMS.

In the 'midships house on the boat deck, which is raised in order to give extra height to the public

rooms, there are twenty-eight state rooms arranged for single berths and two or three berths. These rooms have square brass windows on the side of the house and are very light and airy. They are well equipped and the passages leading to the different rooms are finished in hardwood. Forward of the passenger accommodation is the gymnasium, which is furnished with the latest apparatus for physical exercises. At the forward end of the deck are the officers' quarters and the wireless offices. In fine weather the sides of the boat deck can be used for promenading, and as the 'midships section indicates, this deck extends outside the full width of the ship, the amount of overhang being 2ft. at each side.

Below the boat deck is the promenade deck, on which nearly all the large first-class public rooms are arranged. These comprise the palm court and ballroom, the long gallery and the main entrance hall, with the adjacent writing and card rooms and the social hall, smoking room, and verandah café, also a room intended for children. We have specially chosen for illustration the palm court and ballroom and the verandah café, which are reproduced in Figs. 4 and 5. A feature of the ship is the very carefully executed and well-chosen woodwork, which is made to serve decorative ends. Thus, in the palm court and ballroom the walls are panelled in natural oak, which is enriched with carving and gilding, and a Japanese note of decoration introduced. A further feature of this room, which is open on three sides, namely, forward and to port and starboard, is the excellent lighting system provided by the wide windows and the artistic effect introduced by concealed electric lights in the ceiling, which are designed to give colour changes. As our illustration shows, a band platform is provided. Attention may be drawn to the revolving "Punkah Louvre" ventilating fittings which are arranged in the ceilings of the rooms. The long galleries and the main entrance hall serve to connect the ballroom with the main lounge and the smoking room with the verandah café aft. In all these rooms very pleasing decorative schemes, including some in hardwood, have been carried out. Forward of the after screen bulkhead is an open deck space which can be utilised as a promenade, there being a clear track 18ft. wide on each side of the deck-house. This deck also extends 2ft. out from the full width of the ship on either side. In a deck house aft on the promenade deck there is the second-class smoking room and entrance hall with appropriate promenade space. The principal passenger cabins are on the bridge deck, and they include two *de luxe* suites, twelve special rooms and sixty-one first-class state-rooms. A very high standard of public room and cabin accommodation has been adopted throughout for all classes of passengers.

The principal dining rooms are on the upper deck and the first-class dining saloon with the two adjoining private dining rooms accommodates 294 persons. It is approached by a foyer with alabaster marble and bronze decorative effects. Another attraction for first-class passengers is the 30ft. by 20ft. swimming bath on the main deck amidships, which has a depth of 7ft. 6in. It is served by a passenger lift. The third-class passenger accommodation, and also that designed for Asiatics, are arranged fore and aft, and a special kitchen and dining room for the latter class of passenger is provided.

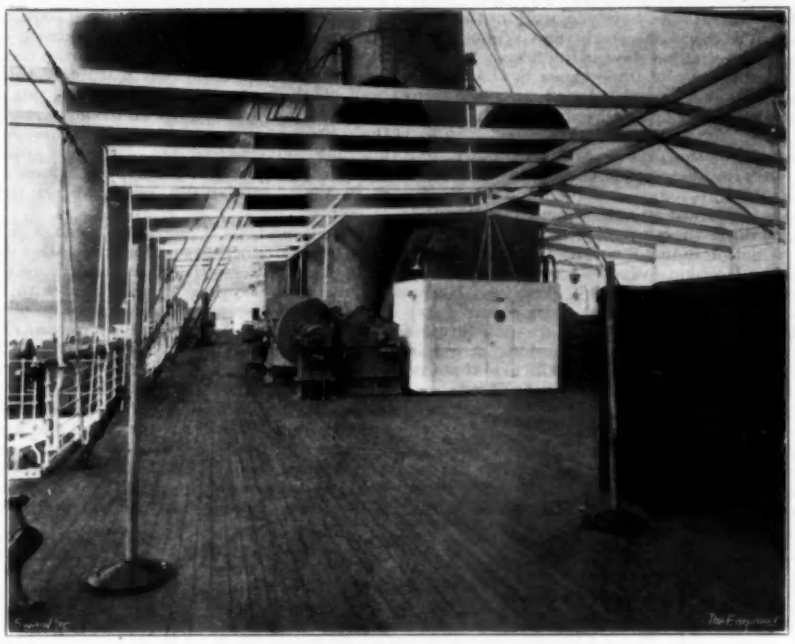


FIG. 3—THE SPORTS DECK LOOKING AFT

FIG. 4—THE VERANDAH CAFE

FIG. 5—THE PALM COURT AND BALL ROOM

DECK AND OTHER AUXILIARY MACHINERY.

With the exception of one compartment, which is flush decked for the stowage of motor cars, the whole of the orlop deck is reserved for cargo. There are six cargo holds and 'tween deck spaces for cargo, which all have widely spaced pillars to facilitate stowage, while in the main 'tween decks cargo doors are arranged in the sides of the ship. Special spaces for the carriage of silk are arranged on the main and lower decks and suitable hold fittings for such valuable cargo have been provided. On the lower deck aft there are the insulated cargo chambers, and forward of them are cooled chambers for ship's provisions. In the cool chambers both brine-cooled and cooled air spaces are available.

The refrigerating machinery was supplied by J. and E. Hall, Ltd., of Dartford, and it comprises two separate CO_2 compressors, which are of the latest vertical type and are coupled direct to electric motors through flexible couplings. The compressors are placed in the shaft tunnel space and immediately aft are the evaporators, the brine return tank and distributing boxes, while above are arranged the air cooling batteries with their fans and electric motors. In the provision chambers there are two large ice-making tanks, while cool cupboards are also provided in bars and pantries which are worked by "Hallmark" methyl chloride plants.

We have already referred to the "Punkah Louvre" system of ventilation. In addition to the natural ventilating system an elaborate system of mechanically-supplied cold and heated air, together with a mechanical exhaust system, has been installed by the Thermotank Company, Ltd., of Glasgow, the latest types of patented "Punkah Louvres," both fixed and revolving, being employed throughout the vessel. Such a system enables the ventilation to be readily adapted to the varying climates in which the ship trades.

The electric lighting of the ship has been carried out on a lavish scale with up-to-date methods, and, in addition to the main generating plant in the Diesel generator room, there is a small high-speed Parsons-Allen generator set, which is placed on one of the upper decks and is designed to supply all the important lighting and power services should the main supply fail.

In our next article we shall deal fully with the high-pressure single-reduction geared turbine propelling machinery and the Yarrow water-tube boiler installation, which embodies several new and noteworthy features, as does the special arrangement of auxiliary machinery. Meanwhile, with the consent of the owners, we are able to give some interesting performance figures which have been taken from the engineer's log on the homeward run of the "Empress of Japan" from Quebec to Southampton before she sailed for the Orient. The service results both on the voyage from Liverpool to Quebec and that from Quebec to Southampton were most satisfactory and fully confirmed the excellent figures which were obtained during the builders' trials. They are as follows :—

Voyage Results.

Displacement of ship	27,400 tons
Speed	21·09 knots
Fuel per day for all purposes at 19,000 B.Th.U.	168·8 tons
Fuel per day for propulsion only	154·0 tons
Shaft horse-power	26,100
Fuel per S.H.P. hour for all purposes	0·603 lb.
Fuel per S.H.P. hour for propulsion only	0·552 lb.
Admiralty coefficient	326
Fuel coefficient (at 19,000 B.Th.U.)	55,200
Vacuum at 30in. barometer	28·5in.
Boiler efficiency	88·3 per cent.
Funnel temperature	249 deg. Fah.

These figures show an advance of about 12 per cent. on the best results obtained with the "Duchess" class

of liners referred to by Mr. J. Johnson in his recent paper read before the Institution of Naval Architects. When the fact that the machinery of the "Empress of Japan" is now running somewhat below full power and minor fuel adjustments have still to be made, the result is one which must be most gratifying to Mr. Johnson and to the owners and builders of the ship.

(To be continued.)

Modern Die-Casting Practice.

By ERNEST V. PANNELL.

No. I.

Introduction.

In surveying the present status of the art of casting non-ferrous metals by pressure it is found that the most considerable development has been reached abroad, and it is inevitable that a paper of this kind should deal largely with foreign methods. Few, if any, of the surrounding conditions are purely local, however, and it is believed that die-casting methods which have been proved economical and technically sound in one part of the world will be equally applicable in any other. Progress in this art has been marked by successively higher casting temperatures ranging up from the early use of tin melting at 230 deg. and lead alloys melting at 330 deg. Cent. to the later development of zinc alloys melting at 400 deg. to 420 deg. Cent. Not until 1914 was it found commercially practicable to produce aluminium alloy castings with the necessary temperature of 660 deg. Cent. and brass pressure castings melting at approximately 900 deg. Cent. are only just, in this year 1930, entering the commercial stage. At the present time the improved alloys of zinc form the bulk of all the die-castings produced, it being estimated that, on a conservative basis, the annual production of these is in the neighbourhood of 25,000 tons. The light alloys are next in order of importance with a production of about 7000. Tin and lead base alloys no longer form a very significant percentage of the total, while, as already mentioned, brass castings are not yet commercially important.

Some general conceptions of die-castings may here be referred to. Porosity and unsoundness are generally regarded as characteristics of the product. This is not entirely true. It depends on the thickness of sections in the die and other factors. Actually, a casting has a hard dense skin, and with thin sections, well chilled and vented, interior porosity will be virtually absent. Where the sections are thicker than ¼in., there will be increasing tendency to a porous structure, and thick portions of the casting may be found to cavitate or show interior shrink holes. Correct gate position and size, adequate venting and the use of suitable alloys are the only means of minimising this trouble. Another common impression has reference to the minimum economic number of pieces which can be pressure-cast, this being variously stated at 10,000 to 20,000. Actually, it is often economical to die-cast much smaller quantities. Some pieces cannot be produced in any other way except by assembly; in other cases, considerable machining can be saved or eliminated, die-casting is, therefore, the economical recourse.

A modern factory devoted to the production of die-castings will consist mainly of five departments—(*a*) metal melting, (*b*) die-casting, (*c*) trimming, (*d*) enamelling and plating, (*e*) die-making.

Metal is actually mixed and melted under careful control and fed in a molten condition to the metal pots of the die-casting machines. For this purpose large ladles swung from an overhead runway are employed. The die-casting department proper consists of machines in rows separated by sheet iron partitions. A gangway along the rear of the row permits access for feeding metal while that along the front allows of the trucking away of the castings as finished.

Each machine in its own cubicle is fed with oil or electricity for mechanical operation, gas for heating, air for operating plunger or otherwise propelling metal, water for cooling the dies and usually low-pressure air for blowing out cavities. One machine may produce from 100 to 400 castings per hour, depending largely on the simplicity of the die and on the rate at which it can be cooled. This output may be attained with one operator or two, depending on the degree to which it is expedient to make the operations automatic. In the trimming department band-saws and punch-presses are employed for the removal of flashes and gates and the usual lathes and drills for turning, drilling and tapping. These operations follow a general inspection for the detection of defective castings. Enamelling and plating departments are equipped also for tumbling, dipping, rinsing and drying of the castings, after which they can be finished in any way desired. All these operations are automatic, using a conveyor system.

The die department is not infrequently the largest and most important part of the whole factory, and is, of necessity, equipped with modern machine and bench tools, and with electric heat-treating furnaces. In addition to the foregoing, there will, also, be air-compressor plant and oil pumps and accumulator to provide the actuating medium for the machines. An extensive drawing-office is also usual. It will, therefore, be seen that a very complete organisation is required to make die-castings on a commercial scale. Nevertheless, there is a distinct tendency for manufacturers to introduce die-casting machines into their existing plants as an auxiliary to their other manufacturing methods. This is particularly true of the manufacturers of telephone equipment, small electrical fittings and motor parts. Several makes of casting machine have now been standardised and are sold and put into use in the same manner as machine tools, generally, with satisfactory results. As a general rule, however, work of the more intricate kind is most effectively and economically handled by the specialised die-casting firms. Of these there are some twenty of importance in the United States, many of which have developed their own principles, machines and practice through a long period of years.

The products of the process are well known. In the early days of die-casting they were produced mainly as a substitute for sand castings and stampings. In such fields important advantages were the elimination of machining, the perfect interchangeability of parts, the reduction in metal weight and the high rate of production. Machine designers are now accustomed to specify die-castings in everyday practice. Naturally, the size and importance of castings has shown considerable development. Many are now greater than 3ft. along their maximum dimension. A weight of individual casting amounting to 15 lb. in aluminium alloy and to 30 lb. in zinc is not unusual.

Die-casting Machines.

All machines are alike in having a pot in which metal is kept fluid and a die carriage in which the dies are parted or closed and racked up close to the metal pot for casting. The pot is almost invariably of cast iron, rectangular in shape, and holding about 100 lb. to 400 lb. of molten aluminium. It is seated in an outer housing lined with firebrick and is heated by gas. Differences exist mainly in the method of bringing a charge of hot metal from the pot into the gate of the die, and may be classified as (*a*) plunger type with centre gate, (*b*) gooseneck type with centre gate, (*c*) gooseneck type with side gate. In the first type a plunger and cylinder are immersed in the metal pot and actuated by an air cylinder outside. On the up stroke the plunger draws its cylinder full of metal; on the down stroke this charge is propelled through a port into the gate of the die, which is held closed under pressure. In the early machines of this type the plunger was actuated by a hand lever of considerable length to produce the requisite thrust. As above indicated, this motion is now effected by air pressure. In this manner a very considerable force can be exerted on the metal as the air cylinder will normally be appreciably larger in diameter than the plunger, and the pressure is, of course, increased by the square of this ratio. Other forms of machine in which the air pressure is applied direct to the surface of the metal lack this advantage, and are more liable to drossing. Metal at high temperature, particularly aluminium, causes rapid deterioration and seizing of plunger mechanisms, and the use of this machine on a practical scale is strictly confined to zinc or other alloys melting at less than 450 deg. Cent. Because of the considerable revival in zinc alloy die-castings during the past few years, however, there has recently been no inconsiderable development in modern automatic plunger type machines. One design coming into extensive use—the "Stern" machine—comprises the usual metal pot and die carriage, but the latter is stationary, and carries the fixed portion of the die. The metal pot, plunger and gate portion of die are one unit and travel to and fro horizontally to open or close the die; meantime the nozzle of the plunger mechanism is in permanent contact with the gate. This differs from the majority of machines in which the die carriage moves up to or over the metal pot. Electric motor drive is employed for actuating this machine, the mechanism being driven by heavy machine gears. One unskilled operator only is used, and the movement of one hand lever causes the machine to go through a complete cycle of operations without further manipulation. In other words, the dies will close automatically, and the cores will be inserted. Molten metal is then shot into the die at a pressure up to 1000 lb. per square inch. Pressure is then released, cores withdrawn, die opened and the casting ejected. The latter is picked up by the operator's tongs and examined. The die is then blown out and the machine is ready for the next cycle. While the complete cycle takes appreciable time to describe, it is actually accomplished in a few seconds and the maximum production of the machine described when fully automatic is as much as 400 shots per hour. Cooling of the dies by water circulation is an important feature of this machine, because the output is so high that this forms the principal limitation. An additional feature is that the plunger mechanism can be removed and the machine converted to one of the air pressure type, suitable for casting at high temperatures; however, it is most successfully operated on the plunger principle.

The second type of machine (*b*) was evolved shortly after the introduction of aluminium alloy die-castings in 1914, and afterwards improved. Since the plunger design cannot be satisfactorily used with aluminium alloy, it was necessary to devise some other way of handling the metal, and for this purpose a closed metal ladle or receptacle is immersed in the pot. This ladle, commonly termed a gooseneck, is furnished with two small nozzles, usually at opposite ends; if air under pressure is blown in at one, the metal will be forcibly ejected from the other. By a suitable arrangement of cams and levers the gooseneck is dipped into the liquid metal to fill it, lifted out again, and the nozzles held forcibly against the air outlet and the gate respectively. Pressure is then applied and the metal is shot into the die. During the past fifteen years a number of patents have been granted for various shapes of gooseneck and for actuating mechanism, but the principle of practically all machines is as described. It may be asked whether aluminium does not attack and dissolve the metal of the gooseneck just as vigorously as in the case of the plunger and cylinder. This is, of course, true, but the machine will continue to operate in the meantime, whereas the plunger would be rendered quite useless in a short time. Because the gooseneck machine can be employed with either heavy or light alloys, it has a wider appeal than the plunger design. The modern production machine is typified by the illustration showing an extensively used design—Fig. 1. It will be noted that the die carriage is mounted on what is virtually a heavy machine lathe bed. The cover plate or platen which forms the base of the die and which is drilled in the centre for the gate is permanently mounted at one end of the bed contiguous to the metal pot. On this plate will be bolted the fixed or gate portion of the die. The other portion is attached to the movable plate, so that the die halves can be closed for casting and opened for ejection of the product. Motion is imparted to the die carriage by the hydraulic cylinder, which utilises oil pressure, but the actual locking of the die is accomplished by a powerful toggle and cams. It should be observed that the whole force of the metal under pressure tends to thrust the die halves apart. For example, with a working pressure of 500 lb. per square inch and a die 10in. square, the total force tending to open the dies is 500 × 100, or 50,000 lb. This must be resisted, not simply by the pressure in a hydraulic or air cylinder, but by a positive locking mechanism. The operator has two levers. The first admits oil to the cylinder causing the dies to be closed and locked, the cores set and the gooseneck raised and locked in position; while the second admits air pressure to the gooseneck, shooting the metal into the die. Interlocking provides that air cannot be admitted until the previous motions have been carried out, and the whole mechanical system securely locked, otherwise danger would arise by metal being shot into the casting room. Similarly, the die mechanisms are interlocked, so that the cores must be drawn before the die is parted. If

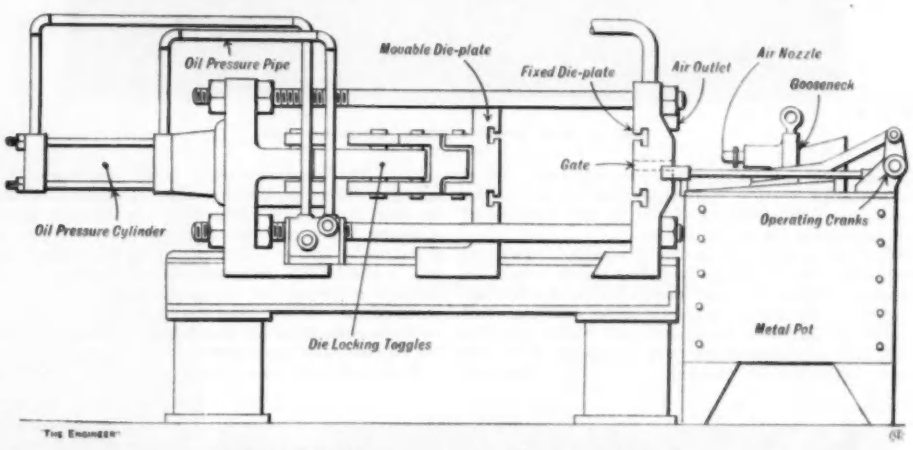


FIG. 1—TYPICAL MODERN DIE-CASTING MACHINE

the operations were inadvertently performed in the reverse order, the cores would, of course, be fractured, and the die be seriously damaged. In cases where it is not desired to use fully automatic operation, the machine must be handled with intelligence to provide against this. A considerable amount of power is required to withdraw a number of cores, and it is thought by some that electric motor operation affords a better means of obtaining it through the necessary gearing than a hydraulic straight line motion using levers and cams. The machine under consideration is generally operated on a semi-automatic principle; that is, cores are set and pulled manually, but the other motions are entirely mechanical. This machine in its larger sizes lends itself particularly well to the production of the heaviest type of die-casting for which fully automatic operation would not offer any great advantage. It is noted that this machine embodies a centre gate as opposed to a side gate; this has the advantage that only relatively cool metal flashes into the parting line, and that the casting can be gated into the heaviest section. Centre gating is apparently more logical, and more in accord with traditional foundry practice. There is also less risk of dangerous spattering, and, lastly, there is no tendency for the gooseneck nozzle to force apart the two halves of the die.

A machine of the third type (*c*), using a gooseneck and a side gate mechanism, is shown in Fig. 2. This

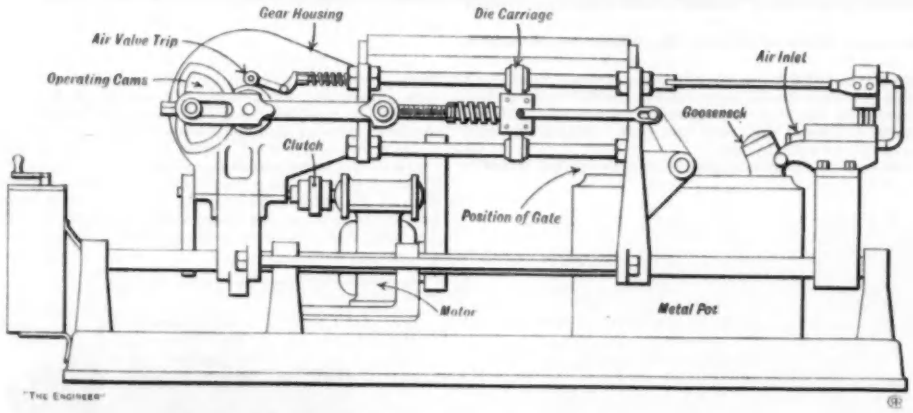


FIG. 2—DIE-CASTING MACHINE WITH SIDE GATE MECHANISM

design, in common with those previously described, is of the most modern type, and will work quite automatically under the supervision of one operator. A 2 horse-power electric motor provides the main drive through back gearing and a clutch under control of the operator. Through this gearing the operating cams of the machine are driven; these, in turn, close the die in its carriage by means of thrust rods. A dwell motion is a feature of the cams, in order that the dies may remain closed a perceptible time during the cycle of operations. Positive locking of the dies is secured by the thrust rods, excess travel when the die is closed being taken up by strong spiral springs. This same excess travel operates bell cranks lifting the gooseneck from the pot and aligning its nozzles with the compressed air orifice and gate respectively. Further motion of the cams now trips the air valves,

Typical Modern Die Casting Machines.

Make of machine	Stern.	Lester.	Madison-Kipp
Type of machine	Plunger ..	Gooseneck ..	Gooseneck
Gate position ..	Centre	Centre	Side
Operation ..	Automatic ..	Semi-automatic	Automatic
Actuated by ..	Electric motor	Oil pressure ..	Electric motor
Pot capacity (aluminium)	50 lb.	120 lb.	150 lb.
Gooseneck capacity (aluminium)	—	7½ lb.	15 lb.
Max. size of die	20in. by 20in.	16in. by 16in.	14in. by 14in.
Floor space ..	10ft. by 3ft. 6in.	10ft. 8in. by 3ft. 6in.	10ft. 6in. by 2ft. 10in.
Height	6ft.	4ft. 2in.	4ft. 6in.
Weight, net ..	4¼ tons	2¾ tons	3½ tons

expelling the contents of the gooseneck into the die. Subsequent movement withdraws the cores and opens the die, ejecting the casting, and the cycle is complete. The degree to which automatic operation has been carried in this machine is very remarkable, and with a casting which is easily ejected it is not difficult to see the possibility of a battery of die-casting machines working entirely without attention, except for replenishing the metal pots. As at present used, the products of this machine are generally small parts gated as many as sixteen in a die. A series of 400 cycles per hour is not uncommon, hence an hourly production of 6400 of a given casting is possible. As in the case of the machine last described, it can be employed on either zinc or aluminium alloys at will, it being expedient to change only the gooseneck and metal pot when changing the alloy in order to avoid contamination. Advocates of this machine justify the side gate principle by the argument that it greatly reduces the cost of the die and requires appreciably less travel of the gooseneck than the centre gate type. The casting is also somewhat easier to eject, and since the nozzle of the gooseneck impinges on a perforated hinged plate which swings over the gate, there is no tendency to force the dies apart.

Some general facts concerned with the operation of die-casting machines may be of interest. Plungers and goosenecks are, of course, subject to periodical renewal. The gooseneck, particularly, is liable to a rapid rate of deterioration when used with aluminium. Nozzles are detachable and subject to more frequent replacement because of the periodical impact and erosion by the hot metal. Special alloy steels have been used for this purpose, but without any significant results. Gas is the heating medium almost universally used, largely because of convenience. Burners have to be employed, not only for maintaining the contents of the metal pot fluid, but also for heating the gooseneck, nozzles, mechanism, gates, and dies. No type of oil burner would provide sufficient flexibility. Dies are blown out with air after every cycle, and sometimes lightly brushed with oil at intervals. The nozzle of the gooseneck or plunger may also require wiping at intervals. In gooseneck machines generally, it is the usual practice to dry and preheat the air, and so avoid explosions and minimise drossing. A good deal of judgment can be exercised by the operator in handling the air admission valve for running large castings, the pressure gradually being increased as the mould is filled. With fully automatic machines operated by cams, the flow of metal is predetermined and cannot be modified, for which reason at the present stage of progress these machines are best fitted for small and medium castings, the former being run a number in one die.

Careful control is kept of temperatures, both of the metal and the dies, and for this purpose thermo-couples are inserted in the metal pots and moulds, readings being taken at a central point. Temperature of the dies is usually held at about one-half that of the molten metal. Too low die temperatures result in markings on the surface of the castings, usually sufficient to cause rejection, while metal poured too cold will result in mis-runs. Should the metal or dies be too hot, on the other hand, the usual result is brittle castings and rapid deterioration of the dies.

(To be continued.)

The Sukkur Barrage and Sind Irrigation.

WE have just received from the Directorate of Information at Bombay a copy of the third edition of the official publication, "Sind and the Lloyd Barrage," which has been revised up to June 30th last. We abstract, in what follows, certain particulars which will give our readers the latest available information regarding the progress to date of the great Lloyd Barrage—which is, perhaps, better known in this country as the Sukkur Barrage—across the river Indus.

We have on several occasions in the past, notably in our issue of December 24th, 1926, given descriptions of the gigantic undertaking for irrigation in the Province of Sind, which is in process of being carried out. The project, our readers may be reminded, is intended to secure irrigation to the area comprising parts of the Shikarpur Canals in the Sukkur District and Begari Canals, the Ghar Canals, and the Western Nara Canals Divisions on the right bank of the Indus, to the Khairpur State, the Nasrat Canals, Hyderabad Canals, Jamrao Canals, the Eastern Nara Canals, and a small part of the Fuleli Canals Division on the left bank of the Indus. The whole area under command, excluding Khairpur State, will amount to 7,406,000 acres, of which 5,155,000 acres will be cultivated annually on attainment of final development. The present irrigation in this area extends to 1,830,000 acres and the new irrigation provided will, therefore, amount to 3,325,000 acres. Including Khairpur State, the annual cultivation, when final development is reached, will be 5,453,000 acres.

The Lloyd Barrage, which is situated about 3 miles downstream of the Sukkur Gorge, is to consist of sixty-six spans of 60ft. each, separated by fifty-eight ordinary piers, each 10ft. wide, and seven abutment piers, each 25ft. wide. The total width of waterway provided will be 3960ft., and the overall length of the Barrage between abutments will be 4725ft. The structure has been designed to pass a maximum river flood of 1¼ million cusecs, or about 50 per cent. more than the highest flood hitherto recorded. It may be remarked in passing that 1¼ million cusecs represents a rate of flow of upwards of 800,000 million gallons per day. Each span of the Barrage is to be fitted with electrically-operated single steel gates, designed to maintain a level of 18ft. 6in. above the Barrage sill. A road bridge is to be provided on the downstream side as an integral part of the Barrage. It will be at a lower level than the upstream arches carrying the operating gear of the regulating gates.

Three canals will take off on the right bank and four canals on the left bank of the river immediately above the Barrage. The principal features of these canals are set out in the following table:—

Canal.	No. of spans of 25ft. each in the head regulator.	Designed discharge in cusecs at head.	Length in canal, miles.	Bed width at head, feet.	F.S. depth at head, feet.
Right Bank:					
North-Western	6	5,099	36	165	10·2
Rice	13	10,215	82	243	11·75
Dadu	4	2,837	131	92·5	9·6
Left Bank:					
Eastern Nara ..	16	13,389	531	380	11·5
Khaipur Feeder, East	2	2,094	13	82	8·5
Rohri	12	10,191	209	250	12·0
Khaipur Feeder, West	2	1,936	1	79	8·8
Totals ..		45,761	1,003		

The total length of the main canals, branches and distributaries will be 6234 miles, made up of 1003 miles of main canals, 732 miles of branches, and 4499 miles of distributaries. The total amount of earthwork in the excavation in the canals and channels is estimated at 5,647,000,000 cubic feet. The work is being carried out partly by manual labour and partly by drag-line excavators. Of the latter, forty-six machines were in operation at the date of the Report, their daily output varying between 100,000 cubic feet for the largest and 13,000 cubic feet for the smallest. Their combined capacity approximated to 74 tons of earthwork per minute on the basis of 5½ days of twenty-four hours' work per week. It is calculated, remarks the Report, that that would be equivalent to the labour of nearly 32,000 men working for the full twelve months of the year, or of about 75,000 men employed for the normal working season of five months of the year in Sind.

Commenting on these figures, the Report states that had manual labour been relied on for all the earthwork of the canals, the cost would certainly have been 50 per cent. higher than the actual cost with the use of mechanical excavators. Even at an increase of only 25 per cent. the extra cost would have amounted to 1·65 crores of rupees, or between a million and a quarter and a million and a half pounds sterling. The Report goes on to say that, in any case, it would have been quite impracticable to obtain 75,000 labourers, even if the greater part of the agricultural labour of Sind had been drawn upon, and such a step would have resulted in serious difficulty, if not disaster, to the zamindars, whose agricultural operations would have been brought to a standstill in consequence.

Work on the project was begun in July, 1923. At the end of June last the whole of the Barrage floor had been completed and most of the sixty-six piers had been constructed practically up to the springing level of the arches. In fact, all the under-water work of the Barrage proper had been completed. The only other under-water work remaining to be done was that for the divide walls, which work is to be taken in hand during the 1930–31 season. The greater portion of the superstructure work remains to be done, but all essential construction is expected to be completed by the year 1932, and it is anticipated that water will be available for the new canals in the inundation season of that year. The seven canal head regulators were almost completed at the date of the Report.

Of the estimated quantity of 5,647,000,000 cubic feet of earthwork excavation in the main canals, branches and distributaries, the approximate quantity completed on June 30th last amounted to 3,950,000,000 cubic feet, leaving a balance of 1,697,000,000 to be done. Of the 6234 miles of canals, branches and distributaries to be constructed, 3100 miles—or about half—were finished by the end of June. The remaining length, however, comprised, mostly, channels of comparatively small sections. Progress, states the Report, had also been made with the construction of canal masonry structures, falls and bridges.

The total estimated cost of the project is 20·03 crores of rupees, or, say, £15,022,500.

Double-ended Axle Journal Regrinding Machine.

FOR re-truing railway carriage, wagon and tender axle journals grinding is now generally preferred to cutting, and it is only in exceptional instances that the latter method can be adopted with advantage on the main surface. Rapidity with which axles can be re-trued and replaced is almost equally as important as accuracy in order that the vehicles shall not remain idle, and with both these features in view the Churchill Machine Tool Company, Ltd., Broadheath, Manchester, has recently introduced the machine which is illustrated herewith. In order to simplify the handling of the wheel sets the top of the bed-plate is at the same level as that of the shop floor, so that the rails along which the axles and wheels are run can be continued on to the bed. A self-contained hydraulic lifting jack raises or lowers the work to and from the grinding centre line. These details make the machine independent of the use of cranes. The wheel set which is to be operated upon is rotated on dead centres, the journals being ground by two independent grinding wheel heads. Although the grinding wheels can be set to operate simultaneously, their controls are quite separate, so that, if desired, one journal

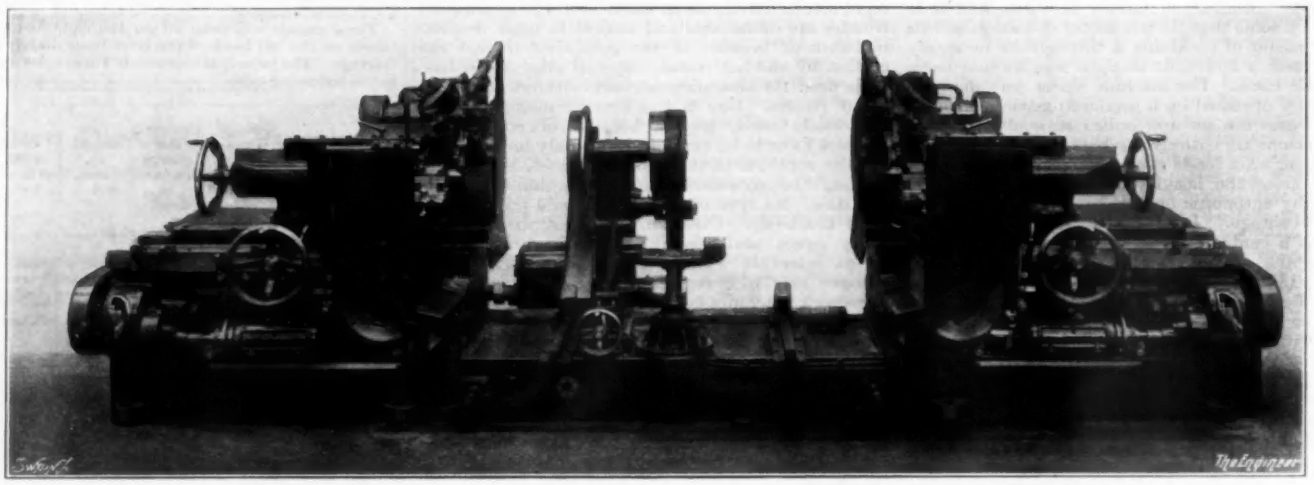
can be dealt with at a time. The convenience with which the machine can be operated is noteworthy. The controls are all at the front of the bed, each lever and hand wheel is placed in an accessible position for the operator, and all hand motion shafts are mounted on ball bearings. In addition to the power traverse, the wheel heads can be traversed by means of hand wheels mounted at the centre of each bed, this hand motion being interlocked with the power traverse so as to be fool-proof. Interposed in the power traverse mechanism is an adjustable shock absorber provided to relieve the gearing of the reversal shock.

The grinding heads which carry grinding wheels 20in. diameter by 5in. wide are mounted on carriages provided with long slides of the double-vee type. In this way wear is reduced to a minimum.

The feed to the grinding wheel can be applied either by hand or automatically, the automatic mechanism being variable so as to give cuts ranging from ·00025in. to ·003in. per traverse stroke. The hand motion to the wheel head can be taken through either of two sets of gearing, one of which gives a micrometer adjustment and the other rapid motion for quickly positioning the grinding wheel in relation to the work. The grinding wheels being 5in. wide, allow for an ample surface even when the edges are trued for grinding the fillets.

A special truing device mounted on each dead centre head provides the means for either radiusing or straight truing the wheel. On each wheel head is mounted a Churchill mirror, an important feature which enables the operator to see the point of contact between the wheel and the journal without moving from his operating position.

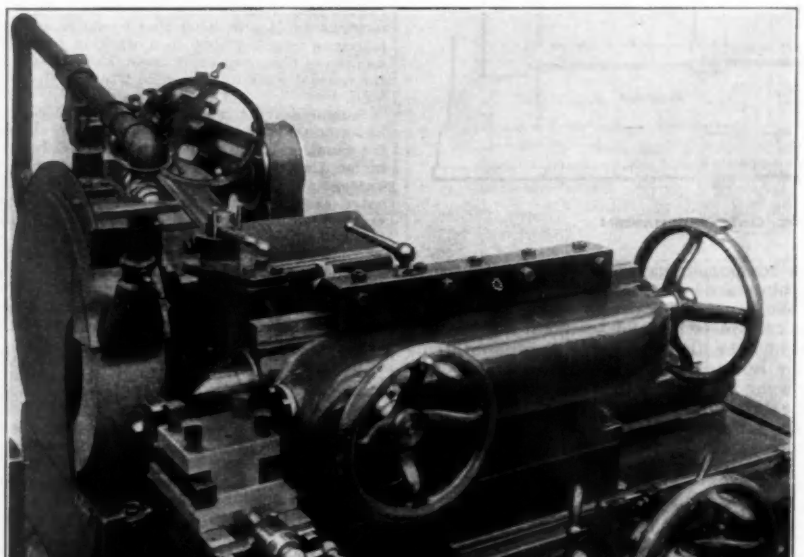
The dead centre heads are of short centre height and are mounted on machined faces on each of the box beds.



RAILWAY AXLE JOURNAL RE-GRINDING MACHINE

addition to grinding, hand-operated tool rests are fitted for turning end collars, fillets or badly scored journals.

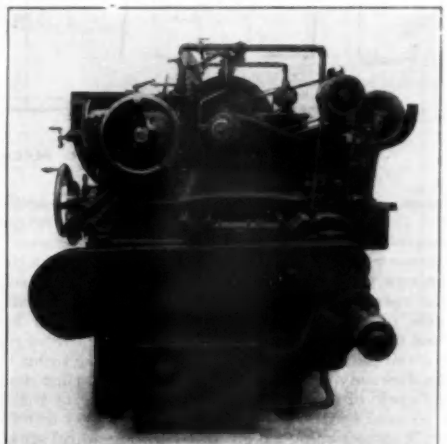
On each end of the bed-plate are mounted the grinding heads with the dead centre headstocks and tool slide. Each head has its independent box bed and is provided with an automatic reciprocating traverse of 18in. There is



GRINDING HEAD AND TOOL SLIDE

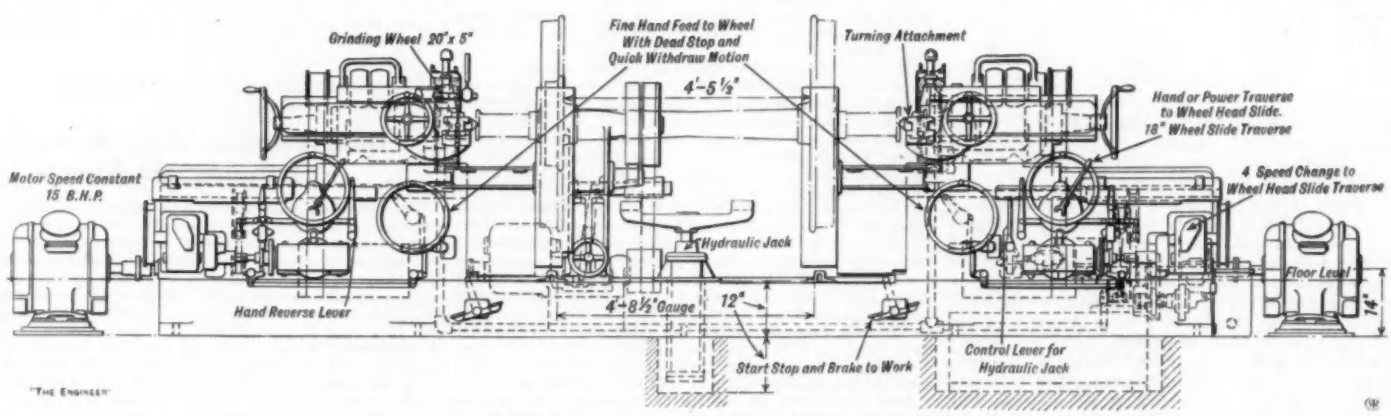
a range of four traverse speeds, any of which can be readily obtained whilst the machine is in motion through a tumbler type gear-box mounted on the end of the bed. The length of automatic traverse stroke to the grinding heads can be very accurately set by means of adjustable trips which are carried on a rack at the front of the bed. These trips are provided with fine screw adjustment, and a thumb latch for rapid positioning, while the reversing lever is fitted with a spring-loaded withdrawal plunger, so that, if required, the head can be allowed to traverse past the position set by the trip without interfering with the length of stroke set by the trips.

They are held in position by bolts sliding in tee slots, so that adjustment for axle length can be made either by moving the complete head or by the screw adjustment of the dead spindle. The method of rotating the axle wheels is by a flat belt having profile blocks which conform in shape to the tread and flange of the tire. The profile belt is driven from a pulley which has a rim section similar to that of the wheel. This pulley is carried on a swinging bracket mounted on trunnions at the rear of the bed. From the main shaft the drive is transmitted to the shaft carrying the profile pulley by belt, and fast and loose pulleys. The belt shifting gear can be operated from either operating position at the ends of the machine. When the work drive is stopped a brake automatically arrests the rotation of the wheel set.



END VIEW OF MACHINE

The distance between the grinding centre and the profile pulley can be adjusted by movement of the swinging bracket, which is controlled from a hand wheel at the front of the bed and provides a means of adjusting the tension


Grinding Wheel 20"x 5"
Fine Hand Feed to Wheel With Dead Stop and Quick Withdraw Motion
Turning Attachment
4'-5½"
Hand or Power Traverse to Wheel Head Slide. 18" Wheel Slide Traverse
Motor Speed Constant 15 B.H.P.
4 Speed Change to Wheel Head Slide Traverse
Hydraulic Jack
Floor Level
14"
Hand Reverse Lever
4'-8½" Gauge
12"
Control Lever for Hydraulic Jack
Start Stop and Brake to Work
"THE ENGINEER"

GENERAL ARRANGEMENT OF JOURNAL RE-GRINDING MACHINE

relation to the work. The grinding wheels being 5in. wide, allow for an ample surface even when the edges are trued for grinding the fillets.

A special truing device mounted on each dead centre head provides the means for either radiusing or straight truing the wheel. On each wheel head is mounted a on the profile driving belt. This form of work drive is claimed to be efficient and exceptionally smooth, as well as being almost instantly applicable to different wheels.

The hydraulic jack previously referred to is built into the bed-plate directly below the grinding centre line, and is arranged in such a manner that the load imposed on the

bed when lifting the wheel sets does not in any way impair the alignment of the machine. Oil is used in the jack to transmit the pressure from a constant-delivery gear type pump, and the oil for this purpose is carried in a tank at the right-hand end of the bed. The pump is below the oil level and is therefore always primed. It is of the same type as is used on hydraulically operated precision grinding machines, and is designed to operate with the minimum of attention. The thrust of the pump gears is taken on ball bearings, and all pumps are tested up to a pressure of 500 lb. per square inch, whilst all piping is of heavy-gauge solid-drawn copper. The movement of the jack is controlled from a valve mounted at the right-hand operating position. The lever of the valve is so placed that the operator can see the centring of the work. The valve is of the balanced-pressure piston type with a self-centring mechanism, so that when the lever is released the valve centres itself, holding the load stationary while the pump runs idly without pressure.

The tool rests, which are mounted in one with each dead centre head, are hand operated and are fitted with double tool fixings. When they are not in use they can be withdrawn longitudinally into a position clear of the journals. In this withdrawn position they do not interfere with the operation of the machine either when grinding, inserting, or removing work.

The machine is driven by two separate motors, one direct connected to each jack shaft at the rear of the bed.

The following are the principal dimensions of the machine:—Length admitted between centres, as required; height of centres, 33in.; standard size of grinding wheels, 20in. diameter by 5in. wide; longitudinal power traverse of grinding wheels, 18in.; horse-power of each motor recommended, 15; floor space required, exclusive of motors, 20ft. by 7ft. 6in.; approximate net weight of the machine when arranged for broad gauge, 26,500 lb.

The Corner Brook Paper Works, Newfoundland.

WHEN the International Power and Paper Company acquired the extensive holdings of the Newfoundland Power and Paper Company at Corner Brook, Newfoundland, last year, it added a powerful asset to its already enormous activities on the North American Continent. The Newfoundland Power and Paper Company was incorporated in 1923 for the purpose of manufacturing newsprint and other products. The development entailed the construction of pulp and paper mills at Corner Brook, together with a complete town site and a large hydro-electric power plant at Deer Lake, 31 miles from the mills. The town of Corner Brook is situated in the Bay of Islands, on the main line of the Newfoundland Government Railways, about 2 miles below the mouth of the Humber River, on the West Coast of Newfoundland.

The paper mill itself consists of four 234in. Walmsley paper machines, operated by Harland electrical drives, and one 120in. Fourdrinier machine on which board and manila are made. It has now a capacity of 400 tons of newsprint per day, and the installation of additional machines is in prospect. The sulphite mill consists of four digesters, 16ft. diameter by 50ft. high, having a capacity of 13 tons of No. 1 sulphite per cook. The ground wood mill consists of twenty-two continuous type grinders, each pair being driven by a 2600 horse-power, 3100-kVA synchronous motor.

The switchboard room in the mill is very impressive, the main board consisting of forty-four vertical panels, besides a four-panel benchboard with two panels for the control battery, and two relay panels. There are thirteen 60,000-volt oil circuit breakers and sixty-one low-tension oil circuit breakers, with capacities of 2200 volts to 600 volts. All the oil circuit breakers are electrically operated.

Paper can be shipped out by water from Corner Brook during eight months of the year, but in the four winter months it is stored in three warehouses which have a total capacity of 50,000 tons of newsprint. Each of these warehouses is 594ft. long by 134ft. wide, and is built of iron and steel framework.

THE POWER SUPPLY.

The mill receives its power from a hydro-electric plant generating 98,000 horse-power. The water is obtained from Grand Lake, which has an area of 215 square miles and a drainage area of 1650 square miles. Owing to the large seasonal variations in the flow of water from this area, the lake is being used as a regulating storage reservoir, with a capacity of about 30 thousand million cubic feet of water. To control this huge reservoir, a hollow reinforced concrete dam, 800ft. long and 75ft. high—now called "Main Dam"—was constructed at Junction Brook, the original outlet of the lake. The water level in Grand Lake is raised some 30ft. by this dam, making necessary a diversion of the railway over Junction Brook on the dam. The main dam has a spillway with a capacity of 26,000 cubic feet per second for the purpose of discharging the occasional heavy floods that occur, or when the lake level rises above the normal operating level. The spillway consists of eighteen gate-controlled openings, each 15ft. wide. Two special portable motor-driven lifting cranes, running on broad gauge rails, are used for lifting the gates. Three-phase, 550-volt power is available from weatherproof plug receptacles spaced across the dam for operating the lifting mechanism. Power is also supplied to the dam and woods department depôt buildings at Main Dam, the pressure being 6000 volts (three-phase). Grand Lake is connected with the power-house at Deer Lake by a canal, 7 miles long, involving the excavation of over 5,000,000 yards of earth. This canal is divided into two sections by Glide Brook Lake, which is artificially formed by two earth embankments, one 4400ft. long with a maximum height of 35ft., and the other 950ft. long with a maximum height of 75ft. By the formation of this lake the total length of canal excavation was shortened by 2½ miles. Glide Brook, with an average flow of about 200 cubic feet per second, discharges into the canal, *viâ* the lake.

CANAL INTAKE WORKS.

To regulate the water flow in the canal, an intake works, consisting of five gate openings, each 20ft. wide by 15ft. high, is placed at the downstream end of the eastern section of the canal, so that the water level of Grand Lake is maintained in this section. These gates have individual electrically-operated remote-control lifting gear. Two travelling gantry cranes used on the construction of the steel penstocks at the power-house, and operating on broad gauge rails outside the building, are available for placing heavy stop logs on both sides of the gates. All openings have curtain walls to prevent trouble from ice and logs affecting the operation of the gates.

FOREBAY.

The arrangement of the forebay at the downstream end of the canal is such that the gate-house is parallel to the banks on the Deer Lake side of the canal, with the seven penstocks to the power-house running at right angles to the canal. Across the end of the canal is a spillway, 160ft. wide, the top of which is at elevation 369, and two automatic Stauwerke gates and an ice chute, all of which empty into the spillway channel running into Deer Lake. A log flume is situated between the gate-house and the ice chute; it is made of riveted steel plate in the form of the letter U and runs parallel to the penstocks. Only a small quantity of water is used in sluicing the logs from the canal into Deer Lake, where they are boomed and towed to the Lower Humber River, from which point they float down to the booms at Humbermouth and are towed to the slasher mill.

The gate-house is a reinforced concrete building, 138ft. by 34ft., covering the requirements of the present development. A light end wall allows provision for future extensions. Seven gate openings, 11ft. 10in. by 11ft. 10½in., are utilised at present, and two spare openings, now blocked with stop logs, provide for future additions to the power-house. The trash racks are built of 2in. by ½in. flat iron on edge, bolted together with spacers at 1½in. centres. The seven gates have individual electric hoisting mechanism, somewhat similar to that used at Main Dam and the canal intake house. Push-button contactor-type starters are used, and the starting arrangements are such that an inching button allows the gates to be opened 1in. when the current is tripped off. The design of the gate entrances and trash racks is such that there is no noticeable loss of head under normal operation with an approximate water velocity of 1·7ft. per second at the gate entrance.

PIPE LINE.

From the forebay the water is carried to the power-house by seven penstocks, each approximately 4000ft. long. For the upper 2500ft. these consist of wood stave pipes with an internal diameter of 9ft. 6in., while riveted steel pipes, 9ft. 6in. in diameter at the top and 8ft. 6in. at the bottom are employed for the lower 1500ft. The wood stave pipes, which are carried down to a head of 170ft. required about 150,000 cubic feet of timber. The steel pipes are laid on the ground and covered with earth to about 3ft. over the top, but the wood stave pipe is supported on concrete saddles clear of the ground.

POWER-HOUSE.

The power-house at Deer Lake is a reinforced concrete structure on a structural steel framework. It is 163ft. by 92ft., and is divided into a generator section having a width of 34ft. and a transformer and switchgear section of 24ft. in width. The generator units consist of seven 14,000 H.P., 375 r.p.m., horizontal type, Francis turbines, each direct connected to a 10,250 kVA, 95 per cent. power factor, 50 cycle, 6000-volt alternator, with direct connected 110-volt exciters. A 20-ton fly-wheel, 12ft. in diameter, is inserted between the turbine and the alternator. The fly-wheel is required for proper speed regulation, owing to the lack of required fly-wheel effect in the generator rotor. Each generator is directly connected with heavy lead-covered cables to a 10,250-kVA, three-phase, 6000/66,000-volt, oil-insulated, water-cooled transformer. These transformers, as well as the oil breakers, are installed in fireproof cubicles. A generator and transformer combine to make an individual unit supplying current direct to the 66,000-volt high-tension bus through an oil circuit breaker.

Electrical controls connected to the switchboard are provided in order that the operator can properly control the loads and also shut down a unit from the control room by tripping the butterfly valve mechanism. Each turbine is equipped with butterfly valve and relief valves to take care of the excess pressure in the penstocks under sudden load changes, as no surge tank is used in connection with the penstocks.

SUB-STATION.

Four transmission lines from Deer Lake enter the sub-station through 110,000-volt wall bushings, connect directly through disconnecting switches to four oxide film lightning arresters, duplicate to those outside the power-house at Deer Lake, and connect through choke coils and four three-pole electrically-operated disconnecting switches, which are also designed for hand operation, to the high-tension volt buses. A double bus system is used for the 60,000-volt buses, two oil breakers being used on each incoming line. This arrangement permits the splitting of the load, so as to take advantage of the best governing units at the power-house in case trouble is caused by speed variation on the synchronous motors operating the paper machines, which are very sensitive to frequency changes. Single circuit breakers are supplied with each transformer bank, and provision is made with disconnecting switches to allow any circuit breaker to be connected to either of the two buses. The high-tension room contains the 60,000-volt oil breakers and lightning arresters.

The sub-station is so designed that one side of the building accommodates the low-tension oil breakers on one floor and the switchboard room on the floor above, which has for its ceiling the floor of the high-tension room. On the other side of the building there is only one dividing floor, between the transformer room and the high-tension room.

There are seven banks of transformers in the transformer room, consisting of twelve 4000-kVA, single-phase, 60,000/4600–2300-volt, step-down transformers, used for two electric boilers, each taking two banks of three transformers or 24,000-kVA; six 5500-kVA, single-phase, 60,000/2300-volt transformers for 2200-volt motors and Corner Brook town power supply; and three 2000-kVA, single-phase, 60,000/600-volt, step-down transformers for 550-volt motors. The 4000-kVA transformers have their secondaries designed for quick connection to 2300 volts in case it is desired to use these transformers for power purposes, other than electric steam generators, at a future date. One transformer of 5500-kVA capacity is utilised as a spare for both the 4000-kVA, 4600-volt, and the 5500-kVA, 2300-volt transformers. The impedance of this transformer is so designed by the manufacturer that the transformer will operate correctly with either the 4600-volt or 2300-volt transformer banks. One spare 2000-kVA transformer is available for 600-volt service.

It is interesting to note that all synchronous motors are started by push-button switches placed close to the motors, but that all starting operations are done by the sub-station switchboard operator, thus concentrating all necessary equipment in the smallest available space, and saving large expense in starting equipment, cables, &c.

Owing to the fact that the sub-station and the whole mill are built on piles on filled ground, over which the tide originally flowed, two overhead passageways are used to conduct the power cables to the mill. The transformer station is situated as nearly as possible to the load centre for the whole plant—that is, the whole plant is practically built around the sub-station, which was one of the first buildings designed.

The following are some interesting figures regarding electrical equipment in the mill and sub-station:—Over 120 miles of wire and cable are installed; over 23 tons of low-tension copper bus-bar, ranging from 6in. to 2in. by ¼in.; over 500 low-tension insulators; over 300 60,000-volt insulators; nearly 15 miles of fibre conduit, ranging in size from 2in. to 4in.; over 40 miles of metal conduit of ¾in. to 2in.; the number of lighting points is approximately 2000; the number of lighting panel boxes, 53; the number of motor safety switch-boxes, 298; the number of 550-volt distribution panels, 41; the number of 2200-volt power distribution centres, 7; the number of switchboard panels, including sub-station, electric drives, and grinder motor governor panels, 120; there are 71 low-tension oil breakers; 13 high-tension oil breakers; 133 high-tension disconnecting switches; and 213 low-tension disconnecting switches; the total number of connected motors, 430, varying in size from ¼ H.P. to 4000 H.P., with necessary starting equipment.

SIXTY YEARS AGO.

WEEK by week we can follow in our columns the development of the tragic disaster which sixty years ago was looming over the French nation. Even as late as in our issue of August 12th, 1870, our correspondent in Paris was reporting the continuation and completion of the arrangements made by decree of the Emperor for the organisation or repair of the railways captured from the enemy or destroyed by the Prussians in their anticipated retreat. It was, however, becoming obvious that the war would not be won by Imperial decrees. The news from the frontier was discouraging and our correspondent had to admit that just possibly a chance might not arise in the campaign then in progress for putting into effect the military authorities' railway arrangements. The admission was significant. More significant was the news that guns were being placed on the fortifications of Paris. Perhaps still more significant was the fact that one of those guns, a huge bronze affair, placed on the left bastion of the Porte Maillot, bore the inscription "Douai, 1830." Turning on a week to our issue of August 19th, we find that Paris had passed from discouragement to terrible anxiety and was feverishly at work on the fortifications. Military men and most others still did not believe that the Prussians would reach Paris, but if they attempted to do so they would, our correspondent said, encounter a fiery furnace. The French nation, maddened by the checks which MacMahon and his fellow generals had suffered, was determined to annihilate the Germans should they advance on Paris. Six hundred guns were said already to be in position on the fortifications, and the number would shortly be doubled or trebled. The ninety-nine gates of the capital were being protected by the construction of moats and 50,000 to 60,000 men, reinforced by naval artillerists, were standing to the defences. For the failure of the French arms to brush aside the Prussians and enter the enemy's territory explanations were, ominously, being sought. So far chief attention was being given, in print at least, to the disappointing results yielded by French military equipment, notably the *mitrailleuse*. That weapon, the darling of the Emperor, had emerged from the secrecy which had hitherto surrounded its construction and had been found to belie the reputation which had been given it. The field which the guns covered was restricted at ranges less than 1000 m., at the battles of Forbach and Wörth their supply of ammunition had given out and their employment as infantry rather than as artillery weapons had not received attention. The Prussians also had *mitrailleuses* or machine guns, as we now would call them, and it would appear that they were of superior design or were better served. We reproduced a letter from a French soldier in the 1st battalion of the 21st Regiment. On August 6th they had fought at Reichsoffen from six in the morning till five. At midday they had been victorious all along the line. At five they were completely routed. The Prussians sheltered in a wood had "mitrailled" the French at a hundred metres. Eight-tenths of the battalion had fallen, only two officers survived, and our soldier had not seen a sergeant-major since the battle. Before the war it had been held that, judging from the experience of the Italian and Austrian campaigns, recent improvements in military arms would in the end cost less loss of life than Brown Bess and her sisters. The Franco-Prussian campaign had already, it was admitted, completely contradicted that opinion.

THE cruisers "Dartmouth," "Birmingham" and "Lowestoft," the last of the coal-fired ships in the British Navy, are to be placed on the disposal list.

Obituary.

CHARLES COURTENAY WHARTON.

Widespread regret will be felt, both in this country and abroad, at the news of the death of Mr. Charles Courtenay Wharton, of the British Thomson-Houston Company, Ltd., which took place on July 30th, while he was on holiday in Yorkshire.

Mr. Wharton, before joining the B.T.H. Company in 1897, was at the Lynn works of the General Electric Company. His first work on joining the first-named firm was connected with the testing of transformers and other apparatus then being built in the small B.T.H. factory at Bankside. Subsequently, Mr. H. M. Hobart—who was in charge of the design work at that factory—formed a technical department, which was the forerunner of the present engineering department, and Mr. Wharton became a member of that group. When the Rugby factory was started in 1901, he became assistant to the chief engineer, Mr. J. S. Conover, and devoted particular attention to the compilation of technical information, establishing the data department, on which he kept a guiding hand till the time of his death. In January, 1906, he was appointed chief of the drawing-office, but relinquished that post in September, 1919, to become assistant to Mr. H. N. Sporborg, chief engineer and director of the company.

In this new position he was called upon to assist in the deliberations of several technical bodies, particularly the British Engineering Standards Association and the International Electrotechnical Commission, for which he did valuable work relating to electrical nomenclature and symbols. He was joint Editor of the "British Standard Glossary of Terms used in Electrical Engineering," and was actively engaged in the preparation of an "International Vocabulary of Electrical Terms." He attended the plenary meetings of the International Electrotechnical Commission in London (1924), Italy (1927), and in Scandinavia this year, as well as special meetings of the advisory committee on nomenclature in Brussels, Geneva and Paris. He was also interested in the work of the special committee set up by the British Association to clarify electrical terms and definitions. Arising from a suggestion made by him, the British Engineering Standards Association took steps to form a new committee to undertake the co-relation of symbols used in all branches of engineering. As chairman of the Terminal Markings Co-ordinating Committee set up by the British Electrical and Allied Manufacturing Association, he did valuable work in the development of a comprehensive system of markings.

Unlike most men who spend a great deal of time dealing with abstruse technical details, Mr. Wharton was most versatile, and in a life crowded with many and varied interests, perhaps the outstanding characteristic was his concern and affection for the rising generation. As far as the B.T.H. Company was concerned, that characteristic showed itself particularly in work for the apprentices. He was for many years a member of the Apprenticeship Committee, and had been its vice-chairman for the last eleven years of his life. This affection for the young was also evidenced by his long association with the Boy Scout movement, and by the active interest he took in the social life of B.T.H. employees.

Mr. Wharton represented Birdingbury on the Rugby Rural District Council and was a member of the Highways Committee.

ALBERT EDWARD SEATON.

It is with great regret that we have to record the death, on Friday last, August 8th, of Mr. A. E. Seaton, who died at his home, Lawn Park, Hemel Hempstead. Mr. Seaton was known throughout the world among marine engineers as the author of "A Manual of Marine Engineering" and other works, and he possessed an intimate personal knowledge of the progress made in marine engineering during more than sixty years.

Albert Edward Seaton was born at Padstow in 1848 and was the son of a shipowner, Thomas L. Seaton, one of whose ancestors was Captain Scoresby, of Polar exploration fame. Young Seaton decided to enter the Navy, and he received his early engineering training at Devonport Dockyard and Keyham College, where he spent the years between 1864 and 1868. On leaving Keyham he gained a scholarship at the Royal School of Naval Architecture and Marine Engineering at South Kensington, where he remained for a further two years. The Principal of the School at that time was Dr. W. C. Unwin, and among Seaton's fellow-students there were several men who afterwards rose to high places in their profession, one of them being Dr. J. T. Milton, who became the Chief Engineer-Surveyor of Lloyd's Register of Shipping. In 1872 Mr. Seaton gained a Whitworth Scholarship, and for a year he served on the staff of the late Sir E. J. Read as technical secretary, engineer officer and inspector. In 1873 he left London for Hull, where he took up the position of chief designer in the engineering department of Earle's Shipbuilding and Engineering Company. In 1879 he was appointed engineer manager of the firm and became general manager in 1882. From 1885 to 1901 he served the firm in the joint capacity of general manager and director.

About that time the Admiralty decided to start an engineering course at Greenwich College for the instruction of junior engineers in the Navy, and Mr. Seaton was invited to give a series of lectures on marine engineering practice. The notes of these lectures, often written in the train when travelling between Hull and Greenwich, formed the basis of his first "Manual of Marine Engineering," which book is now in its twentieth edition. In 1902 Mr. Seaton returned to London and began practice as a consulting marine engineer in Victoria-street. About the same time he was elected President of the Iron Trades Employers' Insurance Association, Ltd., a body which, under his guidance, rose from very small beginnings to a position of considerable importance, and of which he was later made a consulting director. In London Mr. Seaton again identified himself closely with the work of the leading engineering institutions and was a valued member of the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects, and the Institute of Marine Engineers. Naturally, his main interest was in marine engineering, and his principal work was done in connection with the two last-named bodies, although in 1904, jointly with Mr. A. Jude, he read a paper on "Impact Tests on the Wrought Steels of Commerce," before the Institution of Mechanical Engineers. He did valuable work on various committees, and almost up to the time of his death he was Chairman of the Consultative Committee of Shipbuilders and Engineers which was appointed to confer with the Marine Department of the Board of

Albert Edward Seaton

Trade and which dealt with the new instructions for the survey of passenger ships. Another important committee of which Mr. Seaton was the Chairman was the British Marine Engineering Design and Construction Committee, which formulated rules and standard conditions for the design and construction of marine boilers and shafting. These rules were later adopted by several countries. On the various committees of the British Engineering Standards Association Mr. Seaton's authoritative knowledge of marine engineering problems was greatly appreciated, and he was usually the representative of the Institution of Naval Architects and the Institute of Marine Engineers on such work. He was one of the older members of the Institution of Naval Architects and was a member of Council for many years, being elected a vice-president in 1919. Many of the technical papers which he read at different times bore directly on special aspects of marine engineering work and gave an account of the work done by some of the committees to which reference has been made. For several years Mr. Seaton was closely identified with the work of Lloyd's Register of Shipping, and he was Chairman of the Technical Sub-committee. On the manufacturing side, he was a chairman of Belliss and Morcom, Ltd., and a vice-president of the British Electrical and Allied Manufacturers' Association. As a mark of honour he was elected an Honorary Fellow of the North-East Coast Institution of Engineers and Shipbuilders, and also of the Institute of Metals. Among his published works, which were very widely known and appreciated, there was the "Manual of Marine Engineering," already referred to, and the equally well-known "Marine Engineering Rules and Tables" of Seaton and Rounthwaite, besides a treatise on "Screw and other Propellers."

Apart from his very busy professional life, Mr. Seaton found time for further public work as a Justice of the Peace and a member of the Hertfordshire County Council. He had very wide and varied interests and was a recognised authority on many subjects. His charm of personality will be greatly missed by a large circle of personal and business friends.

JOHN PUGH GREGORY.

The death of Mr. John Pugh Gregory is announced as having taken place at Rugby on August 6th.

Mr. Gregory, who had been for many years manager of the British Thomson-Houston Company's Contract Department, was born in Carnarvonshire in 1876, and was educated at Oswestry, and at the Central Technical College, London. He was apprenticed to the marine engineering profession, and afterwards joined the staff of Ferranti Ltd. In November, 1899, he went to America and entered the service of the General Electric Company at Schenectady, remaining there until October, 1900, when he was transferred to that company's London office.

During the following year the B.T.H. Company started its works at Rugby and Mr. Gregory was appointed manager of the Power and Lighting Engineering Department in August, 1901. That department was at first purely technical in character, but it was subsequently changed into a commercial department—the Central Station Department—and ultimately became the present Contract Department. Through all the changes in its name and character, Mr. Gregory remained manager of the department, the principal work of which covered all the company's larger contracts for turbo-alternators, transformers and other power station plant in this country.

It was, we believe, largely due to Mr. Gregory's initiative and energy that the British Electrical and Allied Manufacturers' Association was formed and developed to its present state of efficiency and importance. Not only was he one of the initiators of that body, but he was also one of the most active members of several of its committees.

He was a member of the Institution of Electrical Engineers and an Associate of the American Institute of Electrical Engineers.

The Re-engined Thames Fire Float "Gamma II."

By permission of the Chief Officer of the London Fire Brigade, Mr. A. R. Dyer, we had an opportunity on Tuesday morning of this week, August 12th, of inspecting at Blackfriars Bridge the fire float "Gamma II.," which has recently been re-engined by the Parsons Oil Engine Company, Ltd., of Southampton. The ship, which was fully described in our issue of March 31st, 1911, was built by John I. Thornycroft and Co., Ltd., at Southampton. She has a length of 66ft. 6in., with a beam of 11ft. 6in. and a draught of 3ft. 9in., and her original propelling machinery comprised twin-screw four-cylinder petrol-paraffin engines with a bore and stroke of 8in., giving a designed output of about 160 B.H.P. at 700 r.p.m. In addition to driving the propellers, the engines were also coupled through gearing to four-stage Gwynne fire pumps having a designed output of 600 gallons per minute at a pressure of 120 lb. per square inch. In order to obtain increased speed and engine power twin-screw Parsons oil engines have now been installed. Each of them has six cylinders with a bore of 6½in. and a stroke of 8in., the total designed output of the engines being 170 B.H.P. at 750 r.p.m. On the Thames measured mile off Purfleet a maximum speed of 12 knots was obtained, showing that the re-engined fire float has ample reserve of power for her service speed of about 10½ knots. The engines are of the firm's standard marine type, already described in our issue of March 15th, 1929, and quite a neat engine-room layout has been made. The original pumps and propeller shafts have been retained and the pump drives are now taken through a dog clutch and a shaft which runs along the inboard side of the engine bed-plate, and is housed in four ring-oiled bearings. A flexible coupling is interposed between the shaft and pump couplings. The engines are equipped to start on petrol and to run on paraffin fuel, and electric starting on the C.A.V. principle is included. At the forward end of each engine there is also a C.A.V. direct-current generator, which supplies current for charging the 12-volt auxiliary lighting batteries. The main lighting service is provided by the original auxiliary oil engine-driven dynamo sets. A pipe connection is taken from one of the cylinder covers and supplies air under pressure for operating a "Tyfon" air whistle, in addition to which there is an electric horn worked from the battery current. The pump connections to the monitor fitting on the deck and the hose connections on the delivery boxes forward are retained.

During short demonstration runs which were made between Blackfriars Bridge and Charing Cross we were able to observe for ourselves the quick starting of the engines and their steady running and manœuvring capabilities. The engines are governor controlled and it is possible to go from full ahead to full astern by simply operating the Parsons clutch without having to alter the running controls in any way. All controls, including the battery and ignition switches and the throttle and ignition timing levers, have been brought to dashboards arranged at the after ends of each engine. We noticed that the exhaust pipes are water cooled, giving a cool engine-room. Facilities are also possible for observing the circulation of the cooling water by means of open tundish discharges. After being fully reconditioned and the new engines we have described installed, the "Gamma II.," which has already seen close upon twenty years of service, is now again an efficient and up-to-date unit in the Thames fire-fighting equipment of the London Fire Brigade.

Railway and Road Matters.

THE directors of the London and North-Eastern Railway have appointed Mr. A. Tulip, the assistant dock engineer, to be chief engineer for docks in succession to the late Mr. J. A. Wickham.

IN our issue of March 7th last we described and illustrated a 300 B.H.P. oil engine-driven locomotive which was built by Hudswell, Clarke and Co., Ltd., of Leeds, for the Junin Railway in Chile. The locomotive was put into commission on June 1st, 1930, and is, the makers inform us, operating very satisfactorily.

The length of line used by the East Coast trains between Kinnaber Junction and Aberdeen is part of the former Caledonian system and so is the property of the London, Midland and Scottish Railway. The *London and North-Eastern Railway Magazine* reports that as the bridges on the section in question have been strenghtened, the "Pacific" type of engine can now work the Aberdeen trains. As several of those trains weigh upwards of 500 tons, the introduction of the heavier locomotives should afford a considerable saving in double heading.

IN the discussion, at the recent Glasgow Congress of the Institute of Transport, on the paper by Mr. E. J. H. Lemon on "Railway Amalgamation and its Effect on the Workshops," Sir Henry Fowler said that, in that matter, naturally his own position had been worse than others. When a start had been made there had been about 400 different types of locomotives. He had been working thirteen or fourteen years to cut down the boilers on the old Midland Railway, with its 3000 locomotives, to six types, the life of a boiler in those days being in the neighbourhood of sixteen years.

MEMBERS of all engineering professions are great users of the railway and many of them will therefore be pleased to hear that it has been officially announced that "with a few exceptions, the holder of an ordinary single or return ticket may break his journey, if desired, at any station on the direct route on which he travels." We draw attention to this as one of the standard by-laws of the companies says: "Passengers leaving a train at any intermediate station for the purpose of breaking the journey . . . will be required to give up their tickets at such station and all further rights to such tickets will be forfeited." Another by-law says: "Passengers are not allowed to re-book at an intermediate station for the purpose of continuing their journey by the same train."

THE dismissal of 400 men from the carriage and wagon shops of the London and North-Eastern Railway at York has led to a meeting of the York branch of the National Union of Railwaymen, which branch is said to be the largest shopmen's branch of the union. A resolution was unanimously passed that the railway company should adopt a policy of short time instead of dismissals and pledged itself to loyal acceptance of such a policy. We would, though, have it remembered that, as related in this column on June 20th, when the London, Midland and Scottish Company was dismissing 400 men, the *Railway Review*—the organ of the N.U.R.—admitted that short time did not meet that case, and that for some time it had been obvious that the unions would be faced with the position of extensive dismissals, "and perhaps this is not surprising."

THE question of the development of the use of indigenous timbers for sleepers and carriage building continues to receive attention in India. The last report of the Railway Board states that extended use was made of the North-Western Railway sleeper treating plant at Dhilwan, in the Punjab. During the previous year seven lakhs of sleepers were treated in that plant, of which 312,000 were of *Pinus Longifolia*, and the rest of fir and blue pine. There are still large numbers of chir sleepers, treated by the open-tank method, on the North-Western and East Indian Railways, in good condition after fourteen years' service. The treated chir sleeper is, says the report, at present the most economical wooden sleeper on the market. An incising machine was obtained for use with fir sleepers, to obtain better penetration of the preservative fluid, but considerable difficulty was experienced with the frequent breakages of the knives.

THERE has been considerable correspondence in the *Manchester Guardian* of late under the heading of "Railway Travel," in which there has been a good deal of criticism of British railway methods. Only one point, though, calls for attention in our pages, and that is one on which it may be useful generally to throw some light. One correspondent complained that the night service to and from Paris, *viâ* Dover and Calais, had not been restored after the war and that night passengers were compelled to journey by the longer routes through Newhaven-Dieppe and Southampton-Havre. The explanation for the cessation of the Dover-Calais route is the simple one that the French Government will not send the mails that way and, in the absence of a subsidy, the service does not pay. The reason for the French Government's action is that it is the proprietor of the railway between Paris and Dieppe and half-owner of the Dieppe-Newhaven boats, so objects to pay a subsidy for services it can itself perform.

THERE have been from time to time serious accidents to enginemen, engine cleaners, &c., who have been trapped between locomotives and the doorways of the older engine sheds, owing to the dimensions of the latter not having been proportionately enlarged to correspond with the increased width of locomotives. A similar experience has apparently happened on the Chemins de Fer de l'Etat in France, as we have noticed lately that some of the entrances to engine sheds on that system are now painted red and white at the sides, evidently to act as a warning to men riding on the steps of locomotives. As far as this country is concerned, we would point out that the requirements of the Board of Trade and now of the Ministry of Transport apply only to the running lines, and engine sheds are out of their purview, and so an enlargement of the openings cannot be enforced, not even under the Railway Employment (Prevention of Accidents) Act, 1900. We believe, though, that part of the agreement made last year as to the abolition of the railway passenger duty included an undertaking by the railway companies whereby the Ministry of Transport can interfere in such matters.

Notes and Memoranda.

BASED on the figure reported for June last, exports of galvanised sheets from Japan are at the rate of well over 40,000 metric tons a year. Countries to which sheets are exported include British-India and Asiatic Russia.

AT the recent second annual illumination conference in New York, Dr. E. E. Free, a consulting engineer, urged the adoption of workshops without windows with improved methods of ventilation and illumination. He estimated that omitting windows would effect a saving of about 5 per cent. in building costs and 40 per cent. in maintenance expenses, and would greatly facilitate the control of heating, lighting and ventilating, thereby greatly raising the efficiency of workers.

THE world copper foundry production in June totalled 136,012 tons, being 2692 tons less than in the previous month, according to statistics published by the Frankfort Metal Company. America produced 98,496 tons, or 3284 tons less than in May, the African production remained unchanged at 12,000 tons, while the Asian production increased by 462 tons to 7414 tons. The Australian output jumped from 587 tons in May to 2256 tons, and that of Europe decreased from 17,385 tons to 15,846 tons.

EXPORTS of electric generators and motors from Italy in the first three months of 1930 totalled 720 tons, against 595 and 316 in the corresponding periods of 1929 and 1928 respectively. Of this quantity British India took 161 tons, against 149 and 116; the Argentine, 149 tons, against 53 in 1928; Brazil, 111 tons, against 31. Increases of about 100 per cent. were shown this year in the quantities sent to Belgium, France and Britain. There was a marked falling off in the demand of Germany, Egypt and Uruguay. Spanish business showed a steady improvement. Imports totalled 506 tons in the first three months of this year, against 501 and 940 respectively. Germany supplied 216 tons, against 233 and 181. In 1928, however, there were reparation deliveries amounting to 139 tons. Britain sent 46 tons, against 11 and 3 respectively.

IT is generally known that steel rope when new is able to absorb heavy impact loads that would break it after it has been in service some time. Mr. C. C. Sunderland—chief engineer of bridges, John A. Roebling's Sons Company, Trenton, N.J.—says this is due to the fact that the wires in the strands and the strands themselves have been worked into close contact in service, reducing springiness of rope and resulting in an increased modulus of elasticity. When a rope is first subjected to tension, its elongation consists of both an elastic and a structural stretch. The elastic stretch is that portion of the elongation that shows full elastic recovery upon release of tension. The structural stretch is the elongation which occurs over and above the true elastic stretch for any given tension, and does not show full recovery upon release of tension.

IN his valedictory address to the South African Institution of Engineers, the retiring president, Mr. W. S. Carr, gave the following precepts:—"Be inquisitive about your work. Be not afraid to speak of your failures, they are but stepping-stones to lofty achievement and may help others to avoid similar errors. Never blame your errors of judgment or of conduct upon a subordinate, and always give credit where credit is due. Fears, like difficulties, arise but to be surmounted. Be courteous in all your dealings, with those below you as well as with those above. Cultivate a sense of humour. Cultivate brevity in your reports. Always give of your best to your employer. Above all things cultivate imagination. The engineer must school himself to be a man of quick decisions, and his decisions and judgments must be correct. Be calm under stress. Grudge not a meed of praise when merited."

DICHLORO-DIFLUORO-METHANE has been found practicable for the purpose of extinguishing methane flames, as the result of studies conducted at the Pittsburgh Experiment Station of the United States Bureau of Mines, Department of Commerce. The engineers and chemists at this station are investigating all materials which may be of value in rendering methane, which is the chief combustible gas liberated in mines, less flammable. It had been found that added substances are of value if such additions narrow the limits of flammability, raise the ignition temperature, lower the speed of propagation of flame, or reduce the maximum pressure developed. One of these substances, dichloro-difluoro-methane, which is less toxic than carbon dioxide, is a gas at ordinary room temperature and pressure. Tests have been made with this substance to determine the amounts which must be added to extinguish methane flames, and a comparison made with other substances when mixed with methane. The extinctive effect of dichloro-difluoro-methane is almost identical with that of carbon tetrachloride on a volumetric basis, and is superior to that of such gases as carbon dioxide, helium, nitrogen and argon.

ON July 4th, the first unit of the plant of Torbanite Products, Ltd., was brought into operation at New Glasgow, N.S. Preparations for the recovery of petroleum from Nova Scotia oil shales have been going on at New Glasgow for the past two or three years, and the company named has installed a plant having a capacity for handling 50 tons daily. The present installation is an initial unit only, but others are expected to be added at a later date. The reduction of these shales is accomplished in an air-tight retort invented by Mr. Joseph Ginet, the rock being heated to about 800 deg. Fah. in the retort and the resulting hydro-carbon gases then condensed into oil. From 1 ton of torbanite the average extraction is from 1 to 1½ barrels—40 to 60 Imperial gallons—though as much as 170 gallons have been obtained from 1 ton of shale. The commercial value of the residue is also considerable, as it contains sulphate of ammonia, paint pigments, alumina and foundry moulding sands. The company's intention is to erect a refinery for the treatment of the crude petroleum and the production therefrom of high-grade gasoline as well as a series of lubricating oils, which, on account of their paraffin base, would command higher prices than the ordinary grades. The refinery would probably be erected as soon as the plant was in a position to treat a daily capacity of 500 tons of shale.

Miscellanea.

AN International Exhibition is to take place in Elizabethville, Belgian Congo, during May of 1931.

INDICATIONS of the presence of oil are said to have been discovered at Leeuwhock, in the Middelburg district of the Cape.

A COAL shipping plant with a capacity of 500 tons per hour is being put up at Algoma, Canada. It includes a ropeway 300ft. long and a storage dock of 550ft.

FIRE has destroyed the new Canadian National Railway dock at Vancouver. The loss is approximately 1,200,000 dollars (£240,000). The contractors were to have handed over the completed dock to the Government in two days' time.

THE German tug "Norderney" has arrived at Boulogne with the submarine cable which Germany is to lay between that port and Folkestone as a part of her reparations payments. Operations will start immediately the conditions at sea are favourable.

H.M. TRADE COMMISSIONER at Johannesburg has forwarded to the Department of Overseas Trade particulars regarding the forthcoming tractor trials to be held at Brakpan under the auspices of a special committee appointed by the Department of Agriculture.

THE Central Electricity Board adopted the East England electricity scheme, 1930, on July 31st, 1930, and in accordance with the provisions of Section 4 of the Electricity (Supply) Act, 1926, they have published the scheme as adopted. Copies can be obtained, price 1s. 6d. each, from H.M. Stationery Office.

THE autumn meeting of the Institute of Metals will be held at Southampton from September 9th to 12th. The ninth autumn lecture will be delivered by Professor D. Hanson, D.Sc., vice-president, in the Chantry Hall, Chapel-road. The subject will be "The Use of Non-ferrous Metals in the Aeronautical Industry."

THE directors of British Benzo and Coal Distillation, Ltd., in a progress report, state that the ovens have proved completely satisfactory and that, as regards quantities, all yields per ton of clean coal exceed expectations, except for benzol, which is slightly lower. The cost of operation works out substantially lower than was estimated.

THERE were about 2,757,000 unemployed in Germany on July 31st, of whom 1,900,000 were in receipt of public relief. The latter figure shows an increase of nearly one million over the same returns for last year. The number of unemployed is still growing, and the increase during the fortnight since the middle of July amounted to 51,000.

LATE in the afternoon of August 8th, Lord Stonehaven, the Governor-General of New South Wales, and Lady Stonehaven crossed the new Sydney Harbour Bridge, planks having been placed across the small gap which has not yet been joined up. The two sections of the bridge were then 42in. apart and the lower chords will, it is reported, meet on August 25th, and the arch should be completed on September 16th.

THE Mayor of Hyde, at a recent meeting of the Town Council, expressed on behalf of the Council his thanks to the Joint Electricity Board for its gift of £1000 out of the profits to the funds of the Corporation. Hyde Corporation is one of four districts forming a joint board, and this is the first time anything has been returned by the Board out of the profits, whereas many thousands of pounds have been contributed by way of precepts when the Board was suffering losses.

CREDITON Urban Council has resolved that application be made to the Electricity Commissioners for a Special Order under the Electricity Acts, 1892–1928, empowering the Council to transfer, subject to the approval of the Electricity Commissioners, the undertaking authorised by the Crediton Electricity Special Order, 1925, and the powers of the principal Order to the Exe Valley Electricity Company, Ltd., and to constitute such company the undertaking for the purpose of the principal Order. The Council also resolved that the terms of the draft Order now submitted to give effect to the said transfer be approved, subject to such conditions, alterations, and variations as the Electricity Commissioners and the Minister of Transport and Parliament think fit.

WORK has been commenced in Barcelona for the construction of an aerial cable transporter to convey passengers from the city across the port to the neighbouring beach known as San Sebastian, after the Basque resort. The cable will be nearly one mile long and it will cross the port at the height of 200ft. in order not to interfere with shipping. It will bring the beach within three minutes' journey of the city instead of the thirty minutes required at present. The starting point of the cable will be on the Montjuich mountain, which overlooks the city. The second stage will be a tower 360ft. high situated near the docks. This will be the highest edifice in Barcelona, and it will contain a restaurant and other attractions. The terminus will be a second iron tower, this being 260ft. in height. Four cars, each with accommodation for twenty-two passengers, will maintain the service. The work will cost £75,000. It is hoped to complete it before the end of the year.

THE accounts of the Guildford electricity undertaking for the year ended March 31st show a gross profit on the year's working of £26,869. After deducting interest and repayment of loan charges, there remains a net profit of £2957, compared with £382 last year and £9785 in 1928. During the year 706 new consumers were connected to the mains, bringing the total number to 4581. The units sold during the year increased from 3,469,747 to 6,039,718, equivalent to an increase of over 74 per cent. This rate of increase is a record for the undertaking. The revenue from the sale of 6,039,718 units was £55,042, representing an average sale price of 2·18d. per unit. Meter and other rents, &c., yielded £1830, and sale of fittings accounts for a surplus of £924, making a total revenue of £57,796, an increase of £14,274. The surplus on the year is shown to be £2957, which, added to the balance brought forward from the previous year, leaves the appropriation account in credit to the extent of £24,890.

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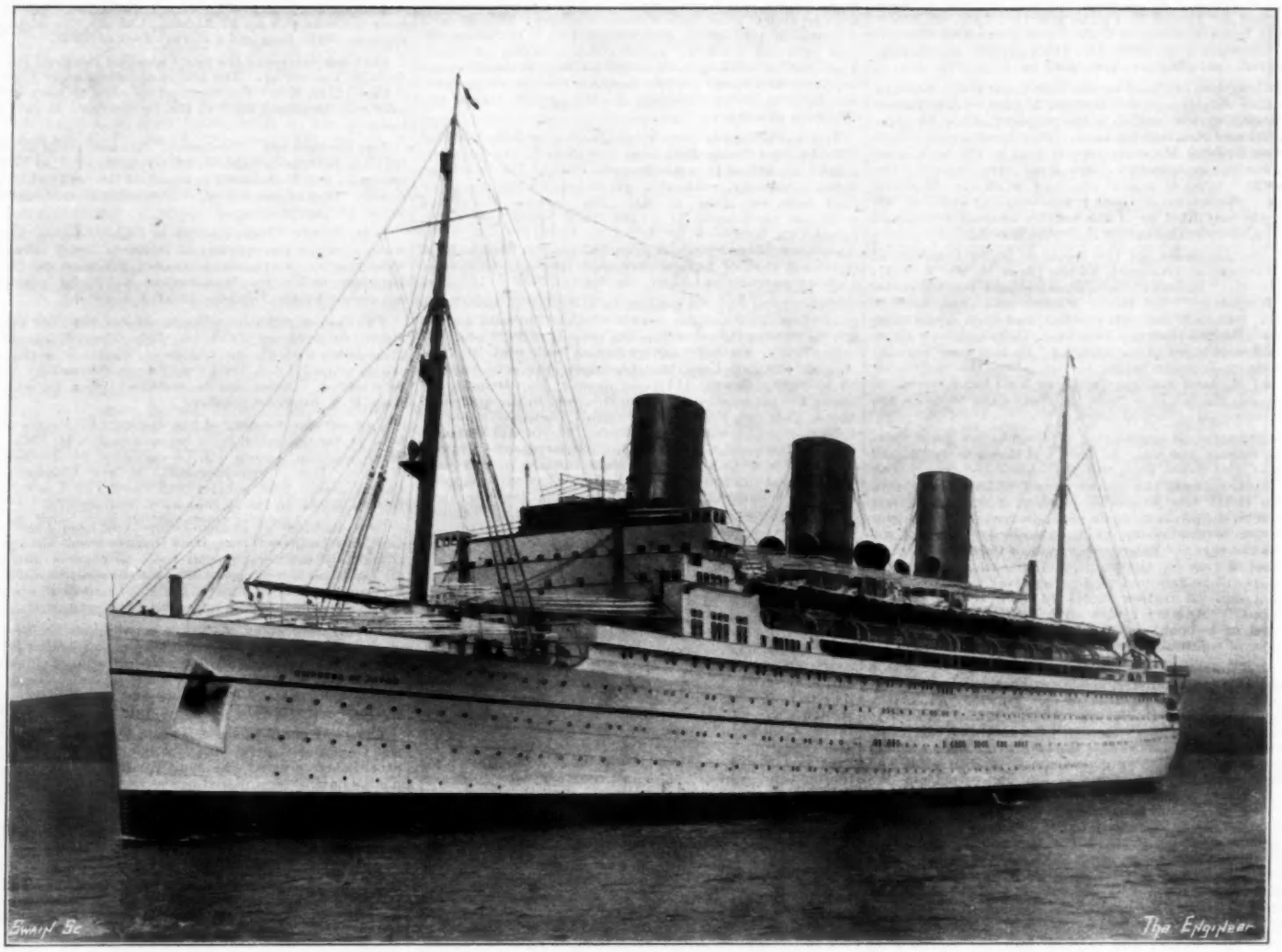

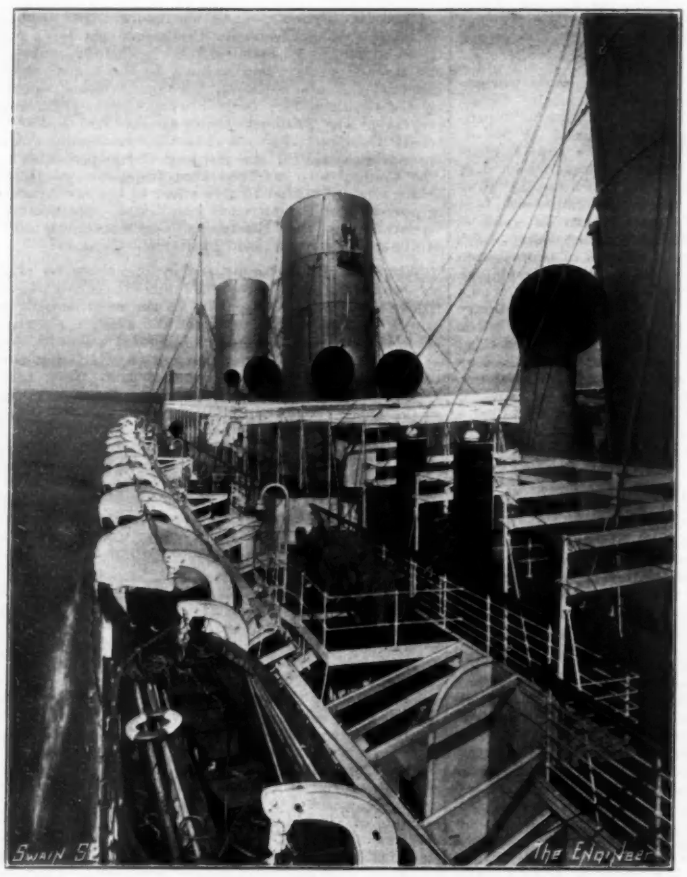

VIEW FROM BRIDGE LOOKING AFT

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DEATH.

On August 9th, at Glendaragh Cottage, Fleet, Hants, Peter Chalmers Cowan, D.Sc., late Chief Inspector of Engineering, Local Government Board, Ireland, in his 71st year.

THE ENGINEER.

Vol. CL No. 3892

AUGUST 15, 1930.

The Commercial Possibilities of the Airship.

The flight of R 100 from Cardington to Montreal, successful in spite of some delay and a slight mishap during the closing stages, has very naturally attracted renewed popular attention to the commercial possibilities of the airship as a means of transport for passengers and freight. Will the airship pay? Within the past fortnight that question must have been discussed several million times. Generally speaking, the public seems to have answered it in the negative, and, superficially at least, it appears to have good grounds for reaching that conclusion. The vast bulk of the craft, the relative smallness of its carrying capacity, the expense entailed in operating it, the delicate handling which it requires at times and the elaborate nature of the mooring arrangements which have to be provided for it, are impressive factors which all seem to tell against the successful exploitation of the airship as a vehicle of commercial transport. As engineers we are primarily more concerned with the structure of airships than with their ability to earn dividends. The two aspects of the subject cannot, however, be completely separated. Having answered the question "Can it be done?" we cannot escape being asked the other, "Will it pay to do it?" With his knowledge of the technical facts and his ability to found on them a sound and reasoned judgment, what view should the engineer support concerning the commercial possibilities of the airship? We believe that the only correct and scientific attitude to adopt at present is to insist that the answer to the second question is as much a subject for practical experiment and as little capable of being completely resolved by *a priori* calculations as the answer to the first. With the object of discovering the commercial possibilities of the aeroplane, a practical experiment, which is still in progress, was begun eleven years ago. It was by practical experiment alone that we or our forefathers determined the commercial possibilities of the mechanical road vehicle, the railway, and the steamship. There is nothing so exceptional about the airship as to justify us in supposing that in the absence of practical experiment we can predict its commercial future one way or the other.

If we examine in detail the principal reasons usually advanced against the possibility of the airship being a commercial success it will be found that each one in turn can be met by an analogy which robs it of its cogency. Consider first the question of size. The R 100 has a total weight or displacement of 156 tons. She is fitted to carry 100 passengers. The structural weight per passenger is therefore 1·56 tons. The "Mauretania" has a displacement of 41,590 tons, and is fitted with accommodation for 1748 passengers. Her structural weight is therefore nearly 24 tons per passenger. Admittedly weight and bulk are not quite the same thing. Admittedly the length of the airship, 709ft., closely approaches that of the liner, 762ft., while the maximum diameter, 133ft., exceeds the vessel's beam, 88ft. But if we exclude the relationship between lineal dimensions and weight, what other accompaniment of mere size are we to consider as foredooming the airship to commercial failure? We ask this question, but we do not suggest that it is unanswerable. On the score of structural weight per passenger the airship wins easily, even when allowance is made for the fact that the liner is capable of carrying in addition to her passengers a considerable quantity of cargo. Turning next to the question of the power equipment, we find that the airship by analogy is not excessively extravagant. In R 100 the engine power provided amounts to 42 H.P. per passenger. In the "Mauretania" the corresponding figure is a little over 36 H.P. Concerning running costs little can be said. We do not as yet know them definitely in the case of the airship, and in the case of the liner they are not disclosed. No useful comparison can therefore be made. As regards capital expenditure, we have definite figures to guide us, but their application requires care. In the House of Lords last June, Lord Thomson stated that R 100 and R 101 had cost together £894,000, exclusive of the money spent on research, sheds, towers, and the organisation of ground and meteorological services. We may take £447,000 as the cost of each ship, although it is known that R 101 was more expensive to construct than R 100. Some allowance should be made for the fact that these airships were the first of their kind. They could be duplicated to-day at a considerably lower cost. It is safe to say that with the establishment of a regular airship building industry a vessel similar to R 100 could be constructed for a capital cost of not more than £400,000, and probably for considerably less. The "Mauretania" cost just under £2,000,000. She was built in 1907. To-day a similar vessel would cost about 25 per cent. more or, say, £2,500,000. We might therefore argue that the capital cost of the airship is £4000 per passenger and of the liner £1430. The comparison is, however, unsound. The respective speeds of the two craft must be taken into consideration. The airship has a cruising speed of 70 miles an hour. The liner has a speed of 25 knots. It is therefore not unreasonable to premise that on a given route the airship would perform at least twice as many voyages per year as the liner. It follows that to earn the same rate of interest on the capital cost it would be necessary for the airship to obtain from each passenger carried a profit 1·4 times as much as the profit obtained from each passenger carried by the liner. That figure is not beyond reasonable expectation. It is affected by two considerations, namely, the increase of fares which the airship would undoubtedly be able to command by virtue of her decreased passage time and the reduction in receipts from the catering department consequent upon the reduced opportunity for serving the passengers with meals. Those who desire to do so may carry out a similar comparison between the airship and the "Bremen," a vessel which is fitted to carry 2200 passengers, which has a normal speed of 27 knots and which cost about £3,000,000. Turning finally to the alleged elaborate arrangements required for handling and mooring an airship of the size of R 100, we note that according to Lord Thomson the two sheds and the tower at Cardington, the towers at St. Hubert and Ismailia, and the provision of ground and meteorological services for R 100 and R 101 represent an expenditure of £1,101,000. At 5 per cent. per annum for interest the passengers carried would have to provide £55,050 each year to meet the terminal charges. On the same basis the passengers carried by the "Mauretania" would provide a sum of £481,000. That figure is vastly greater than the

sum actually expended each year on harbour dues and docking expenses for the liner. Before, however, we conclude that the airship's terminal equipment is extravagantly costly we should require to know what the docking charges and harbour dues for the "Mauretania" would be if she were the only vessel running into and out of Southampton, New York and Port Said.

When it is examined in the light of comparable analogy the argument popularly developed against the commercial possibilities of the airship cannot, it will be seen, be sustained. A similar remark, we are afraid, falls to be made concerning certain arguments which have been advanced to prove that the commercial possibilities of the airship are not only good but brilliant. In a recent issue of the *Financial Times* Sir Dennistoun Burney, intimately associated with the design and construction of the R 100, sought to show that an established Transatlantic airship service could expect to earn a return on its capital of nearly 50 per cent. per annum. He estimated the capital required at £6,500,000, the total revenue at £6,300,000 a year, the annual cost of running the service, including depreciation, at £3,000,000, and the net return at £3,300,000. Sir Dennistoun could readily have arrived at a considerably smaller estimate of the profit to be earned without deserting the ranks of the optimists. Unfortunately, he gives us details of but one aspect of the balance sheet, that concerned with the gross revenue. It is based on single fares of £200 a voyage and on the assumption that the whole of the United States and Canadian mails, 40 per cent. of the existing British mail and 30 per cent. of the existing continental mail would be carried by the airships of the contemplated service. It is unnecessary to dispute these figures. It is sufficient, we think, to point out that shipping companies which can pay a dividend of 5 per cent. are to-day considered to be doing well. There is no analogy in the transport industry for a dividend of 50 per cent. A cold examination of the whole situation leaves us with no unbounded enthusiasm for the commercial possibilities of the airship. Neither does it leave us with the conviction that the general public is correct in its superficial impression of facts and features hostile to commercial success. On every hand essential data are wanting, and until these data are supplied by prolonged experiment in the actual running of airships it must remain unscientific and unwise to form and express any opinion one way or the other concerning their commercial possibilities.

The Railway Position.

THE interim dividends of the four grouped railway companies, which have been announced, make very bad reading not only for investors, railway servants and all financially interested in railways, such as the suppliers of material, but also for the general public, as they, too, are vitally affected by the results of railway operation. The London, Midland and Scottish had, when compared with the first half of 1929, a decrease in receipts of £1,700,000; the London and North-Eastern a decrease of £813,000; the Great Western of £570,000; and the Southern one of £100,000. As a set off, the London, Midland and Scottish saved £700,000 in expenditure, making the loss one of £1,000,000; the Great Western saved £280,000, so that the net decrease was £290,000, and the Southern reduced its expenditure by £45,000 and so made the loss one of £55,000. The London and North-Eastern, on the other hand, has had to add an increase of about £103,000 in its expenditure to the loss in receipts of £813,000 and so raised its deficit to £916,000. The official explanation offered by the last-named company for its failure to keep step with the other companies is that the increase is mainly due to the fact that a greater proportion of the annual permanent way renewals was effected in the first half of this year or earlier than in 1929, to the withdrawal of the 2½ per cent. reduction from salaries and wages as from May 13th, and to the increased price of fuel. On that explanation we would comment that the three other companies also experienced the seven weeks' loss of the 2½ per cent. reduction in wages and salaries, and, presumably, also the increased price of coal. A greater proportion of the annual permanent way renewals having been done in the first half of the year in 1930 than in 1929 suggests the adoption of a policy that is open to criticism. Moreover, as the amount spent by the L.N.E. during the whole of 1929 under the heading of complete renewals of the permanent way, was only £700,000, we cannot see why, when the L.M.S. could save £700,000, the L.N.E. had to spend £103,000 more. But for the explanations offered by the company we should have hazarded the suggestion that, the expenditure under this heading having been £831,000 in 1927 and £783,000 in 1928, there was an economy in 1929—when, as said above, the figure was £700,000—and that, hoping that the increase of £2,000,000 in freight receipts in 1929 would be maintained, more had been spent on renewals during the first half of 1930 to compensate for the lower expenditure in 1929.

When the Railway Companies' (Accounts and Returns) Act, 1911, was passed, the directors and officers of railways welcomed one change then brought about, which was the substitution of an annual report for two half-yearly returns. Thus, the detailed results of working during the first half of the year are not known, and one cannot tell where economies are being effected. From the figures of the four grouped companies given in the tables on page 375 of THE ENGINEER of April 4th last, it will be seen that in 1929, when compared with 1928, expenditure in railway working was reduced by £1,200,000, even although the receipts from railway working increased by £1,300,000. It must, though, be borne in mind that the reduction of 2½ per cent. brought in a saving of £3,000,000 a year, so that it may broadly be said that, but for that deduction, the extra £1,300,000 in traffic brought in last year was earned at a cost of an extra £1,800,000. This year the 2½ per cent. was stopped from salaries and wages for nineteen weeks, and thus, for the last seven weeks of the half year the pay roll would be that much higher than in the corresponding period of the first half of 1929. Putting, on the estimates given by their respective chairmen, the savings in pay on the London, Midland and Scottish at £1,000,000 a year, and on the London and North-Eastern at £820,000, and allowing for the Great Western and Southern taking the balance of the £3,000,000 saved, we may take it that the L.M.S. had to pay £130,000 more during those seven weeks, the L.N.E. £110,000 and the two other companies £170,000 between them. Despite that, the first-named saved, during the half-year £700,000 and the last two £325,000 between them, but the London and North-Eastern increased its expenditure by £103,000. It is, however, useless, in view of the little information available, to make any further conjectures. Let us, instead, consider what can be done to meet the losses in traffic which the railways are experiencing. Our opinion is that the engineering side of general railway working has done all it can to reduce the costs. It is in the "traffic" or operating departments that one must look for greater economy. Therein are practically all the grades covered by the conciliatory schemes, and therefore those to whom the Government was, in December, 1918, generous in granting an eight-hour day to every man, whether employed on a busy main line or on a minor branch, and, in March, 1919, in improving the conditions of service. The latter included a guaranteed week to men in certain grades and a guaranteed day to others. Overtime and night duty was paid for at time and a quarter; all Sunday duty got time and a half; and strenuous work, such as that in the engineering departments, got double pay. Fog-signalmen—whose duties may be tiresome, but are neither onerous nor uncomfortable—received time and a half and their food. Then, in addition, there were agreements as to minimum periods of rest and payment for holidays. Further, in December, 1919, wages, which were at the war rate, were stabilised. All that, and much more, was done during the period of Government control, and the companies had to shoulder it all when decontrol came in August, 1922, and, except that a very few are still affected by the cost-of-living sliding scale, the conditions prevail to-day. Small wonder, then, that, whilst the gross receipts from railway working rose from 120 millions in 1913 to 195½ millions in 1929, or an increase of 63·11 per cent., traffic expenses rose from 23½ millions to 51½ millions, or an increase of 118·68 per cent.

Certain other points, all of which give encouragement as to economies possible on British railways, and present a more hopeful outlook for their future, remain to be noticed. The first is an engineering question. Mr. E. J. H. Lemon, the carriage and wagon superintendent of the L.M.S., read, on July 8th, at the Institute of Transport Congress in Glasgow, a paper entitled "Railway Amalgamation and its Effect on the Workshop." Therein, when describing the progressive system of repairing railway carriages, he said that the time previously required to give a bogie coach a general repair, from the moment of selection till it was again handed over to the traffic department, was fifty-nine working days; it was now twenty-five days; and the thirty-seven days required for washing and varnishing a coach had been reduced to sixteen days. On the same subject we would say that, as reported on page 603 of THE ENGINEER of May 30th, Mr. W. V. Wood, one of the vice-presidents of the company, told the Railway Rates Tribunal that, by reorganising one of its workshops and debiting the capital employed, the L.M.S. was saving £90,000 a year, whilst a further £17,000 was saved by closing another shop. Three of the carriage shops, he added, had been reorganised, with an economy of £9000, £11,000, and £12,000 a year respectively. The reorganisation of the steamship arrangements at Heysham and Fleetwood effected an economy of £111,000 a year. Our second point is to show that these reductions in operating costs do not prejudice the service rendered to the trader. That may be considered as having been proved by the judgment given on June 20th of the Tribunal in its annual review as to whether any modifications in rates and charges were warranted. That body therein said that the evidence was very clear and precise upon the point that expenditure had been reduced without infringing upon the efficiency that is necessary. The third and last point we would notice relates to the possibilities of wage reductions and a modification of the conditions of service. The agreement as to the 2½ per cent. reduction was arrived at just two years ago. It was to have expired in November last, and the companies then asked for its retention for another year. A compromise was, however, arrived at between the companies and the men, whereby it was to continue for a further six months, *i.e.*, until May 12th, and the men, in return, agreed not to ask for any increase in pay or conditions of service until November next. It is safe to anticipate that both sides will then take action, but it is a satisfaction to remember that, whilst the Railways Act, 1921, made the railways into a sheltered trade, by giving the men wages boards, the final court of appeal—the National Wages Board—has an independent chairman, and, besides an equal number of representatives from the companies and the men, has four who represent the users of railways.

Safety in Mines Research.

THE Eighth Annual Report of the Safety in Mines Research Board of the Mines Department* has just been published. The price charged for it gives but little indication of the interesting character of its contents. It deals with the year 1929, runs to upwards of 60 pages, and it is divided into three Parts. Part I. contains particulars of the Research Stations; Finance; the Research Staff, the publication and dissemination of the results of the researches carried out; visits of miners and mine officials to the Research Stations; and research in other countries. In Part II. is given an account of the progress of the safety researches, and Part III. discusses the progress made in connection with the matters dealt with by the Health Advisory Committee of the Mines Department.

COAL DUST EXPLOSIONS.

With Part I. we need not further concern ourselves, but Part II. contains much that is worthy of attention. It is explained at the outset that a simple laboratory test to compare the explosibilities of the dusts of various coals, which enables a rough comparison to be made between one coal and another—providing that they are equally pulverised—has been devised. It is then explained that the statutory regulations of 1920 concerning the stone dusting of pits were based on the knowledge then available. The Board points out, however, that in recent years it has shown that some of the more dangerous coal dusts may be exploded even when mixed with enough stone dust to satisfy the regulations. During the past year it ascertained for two coals the ratio of incombustible matter to coal dust required for safety when there are various absolute amounts of coal dust present.

It has long been common knowledge, the Report continues, that the presence of sets of timber in a gallery may increase enormously the violence of an explosion of pure coal dust. The effect of a series of obstructions on the explosions of mixtures of coal dust and inert dust was studied during the year. So far as the experiments went, they suggest, it is stated, that the presence of timber does not necessitate an increase in the amount of dust needed to prevent the initiation of an explosion.

FIRE-DAMP EXPLOSIONS.

A hand-pick striking a piece of hard rock has been said to be the cause of ignitions of fire-damp, but attempts in several countries to reproduce the condi-

* H.M. Stationery Office, price 1s.

tions had failed until recently. During the year under review, however, the Research Staff at last succeeded in obtaining ignitions. It was found that a short stroke of a 10 lb. or 15 lb. pick, hand-operated, on a very hard sandstone, may ignite fire-damp; not, however, when bright showers of long sparks are produced, but when a glancing blow produces a yellow flash with a small group of sparks which move slowly behind the pick point, between it and the rock. Some half-dozen sliding blows in succession on a suitable rock will ignite the gas. "It would appear wise, therefore," says the Report, "to instruct a man engaged on ripping a roof not to aim blows in rapid succession on the same spot, if the rock is hard. If he takes this precaution, then so far as our experience goes, he avoids danger of firing by his pick an unsuspected accumulation of gas."

In its preceding Report, the Board drew attention to Professor H. B. Dixon's discovery that traces of nitrogen peroxide lower the ignition temperature by some 100 deg. Cent. It is now reported that the same investigator has found that small amounts of carbon dioxide have the opposite effect, though not so marked. "This suggests," remarks the Report, "that some more powerful agent might be found that would raise the ignition temperature considerably. Sufficiently, for example to make a solid explosive incapable of igniting fire-damp in any circumstances. Some years ago we had noticed that the presence of a trace of iodine made ethane difficult to ignite, and quite recently Professor Dixon has found the same substance to have a similar effect on methane. The magnitude and possible utility of the effect are under investigation."

With regard to the rendering harmless of fire-damp by the addition of some inert gas, the Board reports that, during the year, a study was made of the effect of water vapour and other gases. It showed that the order of efficacy is the same as that of the heat capacities of the inert gases; both properties increase in value in the order: Argon, nitrogen, water vapour, carbon dioxide, carbon tetrachloride. Further, a diagram has been prepared, which shows—provided the composition of the atmosphere behind the stopping be known—whether that atmosphere is explosive or not, or whether it may form explosive mixtures on mingling with air.

The greatest violence of a fire-damp explosion is attained in vibratory explosions and in turbulent mixtures. Investigations into the cause of vibrations and into various means for inducing turbulence were continued during the year. The violence of an explosion after it has travelled away from the means for inducing turbulence, was also studied in the 1ft. gallery at Buxton, and it was ascertained that the violence is maintained for some considerable distance beyond the point at which it is induced. "A gas explosion, like a disease, must be prevented if possible; but if one is started, it is more easily stopped in its early stages than later."

In attempting to discover the origin and cause of a mine explosion, one line of investigation is to look for evidences of burning. It has often been tacitly assumed, states the Report, that, in a gas explosion, the gas was present, prior to the explosion, at all places where there was evidence of burning. That is rarely so, however, it continues, for in most explosions the burning and expansion of part of the gas puts the unburnt part into motion, and drives it into places where no gas had existed just previously, and where, shortly afterwards, it explodes. The studies in progress with miniature galleries, branched to represent mining conditions, were well advnaced during the year. They show the distance which flame is projected along the various paths open to it when a section of the gallery containing an explosive mixture is fired at various points. It is considered, according to the Report, that it should prove possible from these experiments, in conjunction with the plans of a pit, to deduce the point of origin of a fire-damp explosion from evidences of burning.

Electrical Researches.

After paragraphs dealing with the "Spontaneous Combustion of Coal" and "Flame-proof Mining Electrical Machinery," the Report proceeds to discuss the electrical researches which were carried out during the year. The chief object of these researches in the past had been to define the conditions in which electricity may be used with safety. Recently an attempt was made to design a cable, which, if accidentally cut, would not ignite fire-damp. Laboratory tests of the experimental cable have, it is stated, proved its efficacy in this respect, and a section is now in service in a mine to provide information as to its robustness in practice.

Some uneasiness having been felt as to the possibility of igniting fire-damp by the discharge of electricity of frictional origin, an investigation was made into the matter. The experiments proved:—(*a*) that streams of certain liquids and of gases containing particles of solids or liquids in suspension, travelling along the insulated pipes, can give rise to electric charges; (*b*) that these charges are unlikely to become dangerous, for the slightest earth connection, even of high resistance, ensures the safe leakage of the electricity before it accumulates. "So far as we can gather," states the Report, "it is only when special care is taken to provide good insulation that dangerous charges can accumulate on piping; it is most unlikely that sufficient insulation ever exists with a pipe line underground."

Falls of Ground.

Following sections devoted to "Mining Explosives," "Safety Lamps," and "Mechanical Appliances," the report proceeds to review the work done in connection with "Falls of Ground." It is explained that research work on earth pressures was continued by Professor S. M. Dixon at the Imperial College of Science and Technology in conjunction with experiments underground. Investigation of the loads of the roof supports at the face in two collieries were made with the aid of special props fitted with dynamometers. Three of these props were set in the Deep Soft Seam at Lowmoor Colliery. The place selected was on a hand-got longwall face advancing to the dip—1 in 12—at a depth of about 600 yards below ground level. The face was supported on "Butterley" steel props with timber plugs set under stout timber lids 13in. by 6in. and 4in. thick, the dynamometer props being fitted with similar plugs and lids. The observations, which were made for 77 days, showed that the load on the props seldom exceeded 20 tons.

Three other dynamometer props were set up in the Six Feet Seam at Llanbradach Colliery, and experiments were carried out on a number of different faces, at some of which the roof was supported by timber props and at others by steel props. The depth of cover was about 730 yards, and the roofs in the area where the props were set gives a good deal of trouble. It was found that, except under special circumstances, *e.g.*, when approaching a fault, the load on the props seldom exceeded 25 tons.

A description is given of a test made on a structure designed to represent the lining of a roadway. It consisted of three straight-sided steel arches, B.E.S.A. Section type A, filled in between with brickwork, the filling being carried right round the crown of the arch. A uniform vertical load was applied on the top of the roadway, and the sides were restrained from moving outwards. The arches were of 4in. by 2½in. section by 11·13 lb. per foot, 8ft. wide by 8ft. high. In a test with only four wood struts, which had been carried out previously, the arches buckled sideways when the load reached 27 tons per arch. The bricked arches, it is stated, deflected considerably at the crown, but carried a load of 67 tons per arch before failure began by the tearing of the fish-plates at the crown. "The results of this experiment," comments the Report, "show the importance of using adequate filling or struts between the arches to prevent sideways buckling, and of using fish-plates strong enough to develop the full strength of the arch section."

Wire Ropes.

Observations on the deterioration of winding ropes in service were continued during the year. In order that as much information as possible may be gained from the tests on samples cut off winding ropes at re-capping, arrangements are being made to carry out, when possible, detailed examinations and tests of other portions of the ropes after their removal from service. In this way it is sought to obtain further data as to the distribution of deterioration along the ropes. The piece of rope lying on the pulley when the cage is at bank sometimes, says the Report, shows more severe deterioration than the portion next the capel, and sometimes the weakest portion is near the centre of the rope, or on the pulley when the cage is being lifted off the pit bottom. The reasons for the localisation of the deterioration at certain places on various ropes are being investigated.

"Several of the breakages of winding ropes which occurred during the year emphasised," continues the Report, "the importance of a careful examination of the rope. In one case a rope showed very severe corrosion and numerous broken wires, and in another the diameter was seriously reduced, yet they were allowed to remain in service until fracture took place. On the other hand, a rope which had previously been in excellent condition broke within a few hours of the discovery of two broken wires. Serious pitting on the surface of the wires was observed on several ropes, although they appeared to be well covered with dressing. It appears that some of the lubricant or dressing material used on ropes is not effective in preventing pitting and further information on the properties of these substances is urgently required. It is hoped to commence an investigation on lubricants and protective materials during 1930."

This Part of the Report concludes with sections headed "Mine Temperatures," "Mine Rescue" and "Mine Ventilation."

Part III. is subdivided into sections on "Silicosis," "Effects of Dust Inhalation," "Hematite Dust," "Dust Traps," "First Aid," "Effects on Environmental Conditions," "Factors Affecting Absenteeism," and "Co-operation with foreign and Dominion Governments."

There are six appendices, which, together, fill rather more than half the book, and most of which consist of progress reports on various researches.

The coal output at the mines of Great Britain for the week ended July 26th was 3,933,200 tons, and the number of wage earners 897,100, against 4,177,200 tons and 897,600 wage earners for the previous week.

German Machine Tools in the World Markets.

Despite the downward movement in the situation of international trade throughout the world and the growing degree of unemployment in Germany, the German official export statistics—quoted by the *Rhein-Westfälische Zeitung*—show that the weight of the exports of all kinds of machine tools increased by 30 per cent. in the first half of 1930 and in value by 16 per cent. over the corresponding period of last year. The figures given for the first six months in 1929 are 50,509 metric tons of the value of 99,976,000 gold marks—say, £4,999,000—and 65,770 metric tons, as compared with 115,637,000 gold marks—say, £5,782,000—in the same period in the present year.

In expressing surprise at the large increase in view of the prevailing world conditions, the newspaper states that, as in previous years, metal working machines have this year also had the largest share in the augmentation, the increase in the weight of the exports having been 33 per cent. In the first half of 1929 the exports of this group amounted to 41,567 metric tons of the value of 86,331,000 gold marks—£4,317,000—and to 56,148 metric tons and 101,917,000 gold marks—£5,096,000—in the equivalent period this year. It is claimed that the results would have been still better had it not been for the diminution in the purchases made by Japan, Poland, Brazil, Spain and Holland. But the losses in these cases were more than compensated by the large increase in the exports to France, Soviet Russia, Great Britain and Belgium.

The German export statistics for 1929 do not particularise the values of the exports according to the countries of destination, they merely state the weights. The most important customers for metal working machines in the first six months of the past two years are set forth as follows:—

	First half of 1929. Metric tons.	First half of 1930. Metric tons.	First half of 1930. Value in gold marks.
France	3,834	10,547	18,388,000
Soviet Russia	3,799	7,181	18,789,000
Great Britain	3,522	5,638	9,641,000
Belgium	2,685	4,839	5,716,000
Italy	2,357	3,213	5,540,000
Czechoslovakia	2,402	3,105	5,160,000

Next in order of tonnage and value come Switzerland, Holland, Sweden, Argentina, Austria, the United States, Spain, &c. The second most important branch of the exports of machine tools is that of woodworking machinery, of which 6509 metric tons of the value of 10,723,000 gold marks—say, £536,000—were exported in the January-June half-year in 1929, and 6689 metric tons and 10,785,000 gold marks—£539,000—in the same period in the current year.

Among the most important purchasers of the woodworking machines increases have been made in the present year by Soviet Russia, France, Switzerland, Italy and Holland, but the deliveries to Argentina, Czechoslovakia, Great Britain, Austria, and particularly to Brazil and Poland have declined. The leading importers of woodworking machines in the first half of the past two years have been as undernoted:—

	First half of 1929. Metric tons.	First half of 1930. Metric tons.	First half of 1930. Value in gold marks.
Russia	202	1,121	1,753,000
France	200	588	912,000
Holland	280	487	688,000
Argentina	592	373	487,000
Switzerland	291	340	564,000
Czechoslovakia	396	338	665,000

In the case of stone working machines it is stated that they play a subordinate part in the total exports of machine tools, although even in that branch there has been an increase of nearly 50 per cent. this year, namely, from a weight of 183 metric tons in the first half of 1929 to 270 metric tons in the same period of this year, the values having been 404,000 gold marks and 568,000 gold marks in the two cases respectively.

The final group concerns the exports of steam-hydraulic forging presses, mixing machines, mechanical hammers, also in connection with electric motors. These exports rose from 2249 metric tons of the value of 2,518,000 gold marks in the first six months in 1929 to 2662 metric tons in the same term in this year, but the value was only 2,367,000 gold marks. Most of these deliveries were made to Russia, Great Britain, Switzerland and France.

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Stress Strain Relationships in Spring Steels.*

By G. A. HANKINS, D.Sc.

SUMMARY.

THIS article gives a short general discussion of stress strain relationships in spring steels under conditions which are often assumed to be elastic, and also includes experimental results on changes in elastic moduli after excessive overstraining of the material.

Attention is first drawn to the approximate degree of constancy of the elastic moduli of all spring steels under normal static loading conditions. Hysteresis loops in stress strain diagrams are then discussed, and it is concluded that hysteresis phenomena in spring steels are similar to those in mild steel, but are much less marked. Experimental results are then given showing that excessive overstraining of a spring steel may result in a small but definite decrease in the elastic constants. The effect of rest and mild heat treatment on hysteresis changes is briefly discussed, and it is concluded that when a spring has been subjected to safe ranges of stress in service subsequent rest or mild heat treatment is of no advantage, but when the material has been subjected to unsafe ranges of stress, then rest and mild heat treatment may prolong the life of the spring.

INTRODUCTION.

During the course of the investigation of the mechanical properties of spring steels which has been carried out at the National Physical Laboratory for the Springs Research Committee of the Department of Scientific and Industrial Research (1), (2) and (3)†, some attention has been given to possible changes in the stress strain relationships of spring steel over deformation ranges in which elastic conditions are often assumed to hold good.

Comparatively little data have been placed on record in regard to such changes, and the present article gives a short discussion of stress strain phenomena in spring steels, together with the results of a few experiments on possible changes in elastic moduli after excessive overstraining had occurred. The work has been carried out as part of the research programme of the Springs Research Committee, and is published with its permission.

GENERAL DISCUSSION.

Attention may first be drawn to the approximate degree of constancy of the elastic moduli of spring steels when those properties are examined under normal static loading conditions. Thus, as a result of a large number of determinations of the tensile modulus of elasticity of eight representative spring steels after various quenching and tempering treatments, it was found that the modulus varied between the comparatively narrow limits of $29{\cdot}5\times10^6$ lb. per square inch and $30{\cdot}9\times10^6$ lb. per square inch. Similarly the modulus of torsional rigidity varied from $11{\cdot}3\times10^6$ lb. per square inch to $11{\cdot}9\times10^6$ lb. per square inch, and it was concluded that mean values of $30{\cdot}1\times10^6$ lb. per square inch and $11{\cdot}6\times10^6$ lb. per square inch could be used for normal design purposes irrespective of the composition or heat treatment of the particular spring steel under consideration.[2] The use of these mean values may be sufficiently accurate for existing methods of design of laminated springs for motor cars, &c., but in many other springs detailed knowledge of the stress strain relationship over the so-called elastic range is of value.

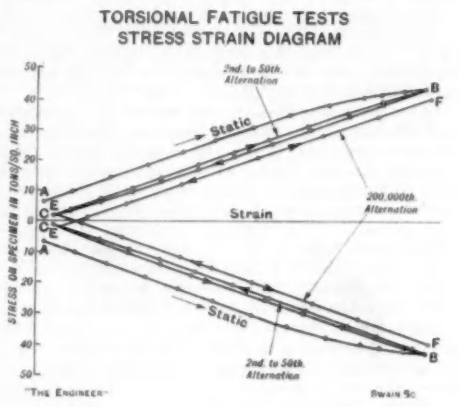
The usual method of determining the elastic modulus of a given steel in a static test is to subject a prepared specimen to increasing loads and observe the resulting strains. A load-strain diagram is plotted and the elastic modulus is then calculated from the slope of the initial part of the diagram on the assumption that stress is proportional to strain. The accuracy of the modulus determination depends on the accuracy used in the strain measurements, and on the extent to which the plotted points lie in a straight line. The point on the diagram at which the first appreciable deviation from the initial straight line occurs is the "limit of proportionality"—sometimes called the "elastic limit"—and the mean slope of the line up to this point is usually taken for the modulus determination. Many careful experiments by various investigators have shown, however, that if relatively small repeated loadings are applied to a steel specimen, then the material may reach a cyclic condition in which the load strain diagram takes the form of a loop. These loops are known as hysteresis loops, and when the same closed loop is traced out continuously on successive loadings the hysteresis is known as "elastic hysteresis." When the applied load cycle causes a small permanent strain in the test specimen, the hysteresis loop is not completely closed, and the maximum width of the loop depends on the previous history of the material in regard to applied load cycles. Following on the valuable work of Bairstow[4] in 1910 considerable information has been accumulated in regard to hysteresis under load in steels,[5] but the experimental work has usually been carried out on mild and medium carbon steels. Recent experiments by the writer,[3] however, in which hysteresis in spring steels was conveniently examined during the course of fatigue tests, suggest that hysteresis phenomena in spring steels are similar to those in mild steel, but are much less marked. Accordingly the simple form of Hooke's law in which stress is proportional to strain does not necessarily represent the behaviour of a spring steel when the stress strain relationship is subjected to close examination, and the elastic modulus cannot always be expressed as a particular fixed value which is independent of the stress applied. When the hysteresis is small and approximately constant it is convenient to calculate the value of the modulus from the slope of the straight line joining the end points of the loop; such values are known as chord values. It should be realised, however, that the width of the hysteresis loop depends on the range of the applied stress cycle, and accordingly the value of the chord modulus is also dependent, to a small extent, on the range of the stress cycle.

When the upper limit of an applied stress cycle is in the region of sensible curvature of the initial stress strain line hysteresis loops of appreciable size are found, and unless the mean stress of the cycle is zero, permanent set may also occur. Thus the accompanying diagram, reproduced from publication reference[3] shows torsional hysteresis loops obtained on a hardened and tempered carbon spring steel of 80 tons per square inch tensile strength. The diagram also shows that the width of the loop diminished during the earlier stages of the test, and by the time the specimen had been subjected to 200,000 stress cycles the loop was inappreciable. It is probable, however, that more accurate methods of measurement would have shown slight hysteresis throughout the whole test. It may be noted that the stress range in the particular test was about 40 tons per square inch, and that the safe range was 44 tons per square inch. In general, it appears from the writer's experiments on torsional fatigue that at both safe and unsafe ranges of repeated strain cycles the hysteresis in spring steels is characterised by unclosed loops during the first few cycles, and then rapid diminution of these loops until a stage is reached in which the loops are extremely small. Beyond this stage the loop either remains constant or tends to decrease very slowly in width. In the final stage of these changes the hysteresis cannot be greatly different from elastic hysteresis, and by analogy with mild steel it seems probable that the size of the elastic hysteresis loop is proportional to some power of the range of the applied stress cycle. In all cases elastic hysteresis in normal spring steels at safe ranges of stress appears to be very small, and for a given stress range appears to be smaller in a high-tensile spring steel than in a low-tensile spring steel. It may be inferred from the work of Aitchison,[6] however, that very high-tensile spring steel, obtained by a low tempering temperature after quenching, may show a low proportional limit and small but definite hysteresis at comparatively low stresses.

Many springs in service are subjected to repeated strain cycles, and any hysteresis in which the loops are not entirely closed results in permanent set in the spring. Thus in the diagram in which ranges of constant strain were actually applied and the corresponding torques observed, the changes in the material caused the resulting mean torque to diminish to a marked extent between the 50th and 200,000th repetition of the strain cycle, although a slight increase in the range of torque necessarily occurred. In the case of an engine valve spring this change would result in a reduced pressure of the spring on the valve, and permanent set in the spring. Apparently this action may occur in springs at safe ranges of stress, and although in some cases, such as automobile laminated springs, permanent set may be less objectionable than actual fracture of the spring, in calibrated springs used for measurements of load permanent set is not permissible. For this latter type of spring it appears that measures should be taken to subject a new spring to a number of initial strainings so that it is in a stable condition in regard to permenent set before it is put into service. When great accuracy in this matter is required, the stress range on the spring should be well below the safe stress range, and a large number of initial strainings may be advisable. In the case of automobile laminated springs it is usual to subject the finished spring to a scragging test in which one or more stress cycles are applied which greatly exceed the safe fatigue stress permissible in the spring. Apart from other considerations, such as the detection of cracks, these high range stress cycles appear to be of value in that they reduce any permanent set which may arise during the subsequent working life of the spring.

CHANGE OF ELASTIC MODULUS WITH OVERSTRESS.

In the case of all springs it is of importance to know whether the mean elastic modulus after overstraining or after changes in the hysteresis loops have occurred is appreciably different from the mean modulus value obtained on the material in its original condition. The accompanying diagram gives a little information on this point. The slope of the first portion of the line A B is proportional to the torsional elastic modulus of the material in its original condition, whilst the slope of the line E F is proportional to the modulus after the material has settled down to a stable condition in regard to hysteresis and permanent set. The order of accuracy is not high, since those observations were not made with a view to examination of modulus changes, but measurements of these slopes indicate that a small but definite decrease in the modulus value has occurred. More accurate measurements of modulus changes after



severe overstressing are recorded in the following experiments.

(A) *Tension and Bending Experiments on Spring Steels.*—These experiments were carried out by the writer in the Engineering Department of the National Physical Laboratory, and give the results of accurate stress strain observations on spring steels before and after the test specimens had been subjected to overstress under (1) direct tension, (2) reversed bending stresses.

The material used for the tests was 0·6 per cent. carbon spring steel, oil quenched from 950 deg. Cent. and tempered at 500 deg. Cent. The results of normal mechanical tests on the material were as follows:—

Brinell hardness number	370
Primitive tensile limit of proportionality, tons per square inch	57
Yield stress, tensile, tons per square inch	73
Ultimate stress, tensile, tons per square inch	79
Endurance fatigue limit (reversed bending), tons per square inch	±38
Modulus of elasticity, lb. per square inch	$29{\cdot}9\times10^6$

(1) *Tension Experiments.*—The tension observations were made on a cylindrical specimen 0·4000in. diameter, and the strains were observed by means of a Marten's mirror extensometer on a 4in. test length. The method of test was as follows:—

(*a*) Specimen was subjected to the load cycle 0·1 ton, 2·5 tons, 0·1 ton, and strain observations were made at loads of 0·5, 1·0, 1·5, 2·0 and 2·5 tons (2·5 tons load gave a stress of 19·9 tons per square inch). The extensometer readings indicated a slight permanent extension. The specimen was loaded a second and third time as before, and no further permanent extension was observed.

(*b*) The extensometer was removed and the specimen was subjected to twenty stress cycles, 0, 8·5 tons (67·6 tons per square inch), 0, each cycle taking about 1½ minutes. The permanent extension of the specimen was found to be 0·01in. on the 4in. test length and the diameter had decreased to 0·3992in.

(*c*) The extensometer was replaced on the specimen and strain observations of the 0·1 ton to 2·5 tons load cycle were made. A small permanent extension was observed. The same load cycle was repeated until no appreciable extension was found in two successive loadings.

The extensometer readings are given in Table I. below. One scale division represents 1/336,000in.

TABLE I.—*Extensometer Readings, Tension Tests.*

Load, tons.	Before overstrain. Extension on 4in. Scale divisions.			After overstrain. Extension on 4in. Scale divisions.	
	Initial loading.	Second cycle.	Third cycle.	First cycle.	Sixth cycle.
0·1	0	0	0	0	0
0·5	—	317	317	325	323
1·0	720	717	716	740	732
1·5	1125	1119	1116	1151	1140
2·0	1532	1519	1518	1561	1547
2·5	1942	1923	1921	1976	1961
2·0	1543	1525	1525	1571	1559
1·5	1140	1125	1122	1163	1152
1·0	736	721	721	752	741
0·5	334	319	317	338	330
0·1	17	1	−1	6	0

It will be noted that a hysteresis loop was obtained in each set of readings, and that the final loops were closed. These readings give some idea of the small size of the elastic hysteresis loops in a typical spring steel. Chord values of the modulus of elasticity have been calculated from the observations and are given in Table II. The values after overstraining were calculated on the reduced diameter of the specimen.

(2) *Reversed Bending Stresses.*—Bending tests were made in a rotating bending fatigue testing machine,

* Communication from the Springs Committee of the Department of Scientific and Industrial Research.

† The numbers apply to the list of references given at the end of the article.

and strain observations were made by means of a mirror attached to the end of the specimen. Uniform bending moment was applied to a test specimen of 0·2000in. diameter over a length of 1·25in. The method of test was similar to that used in the tension

TABLE II.—*Values of E (lb. per square inch* × 10^{-6}).

	Before overstrain.			After overstrain.	
	Loading.	Unloading.		Loading.	Unloading.
Initial loading	29·6	29·85	1st cycle	29·1	29·2
2nd cycle ..	29·9	29·9	6th cycle	29·3	29·3
3rd cycle ..	29·9	29·9			

experiments, and it should be mentioned that the specimen had been subjected to a large number of reversals of bending stress before the present tests were made. The following results were obtained :—

(*a*) Static test to 31·6 tons per square inch, slight loop, no permanent deflection (loop closed).

(*b*) 100 complete reversals of stress at ±70 tons per square inch. Slight permanent bend in specimen was apparent.

(*c*) Static deflection tests over the cycle, 0, +33, 0, −33, 0 tons per square inch. Loops obtained which were not closed.

(*d*) Specimen subjected to 100 reversals of ±36 tons per square inch and two static loadings to 22 tons per square inch. Final loop was closed.

The values of the elastic modulus in the tests were calculated from the chord values of the deflection observations and are given in Table III.

TABLE III.—*Bending Tests, Proportional Values of E.*

	Before overstrain.			After overstrain.	
	Loading.	Unloading.		Loading.	Unloading.
1st cycle ..	1·000	1·000	1st cycle	—	0·985
			Final cycle	0·990	0·990

It will be noted that the results are similar to those obtained in the direct tension experiments, with the exception that the first test in the bending experiments gave a closed loop. This was probably due to the large number of stress reversals to which the specimen had been subjected in the previous endurance tests.

The results show that in both tension and bending there is a small decrease in the value of the elastic modulus after overstressing has occurred.

(B) *Effect of Overstrain on the Modulus of Rigidity.*—The author is indebted to Professor G. Cook, D.Sc., a member of the Springs Research Committee, for the details of the following experiment made in his laboratory at King's College, London.

A bar of mild steel—black rolled—nominal diameter $\frac{3}{16}$in. and about 11ft. long, was suspended vertically, fixed at the top and with a heavy disc of metal at the bottom. The time for 150 torsional oscillations was measured (*a*) in the state as received, (*b*) after ten complete turns had been given to the wire, which it was estimated would overstrain over 95 per cent. of the metal, leaving only a small central core unaffected. The results were as follows :—

No. of oscillations.	Time (seconds). Before overstrain.	Immediately after overstrain.	Three hours after overstrain.
150	522·3	524·7	524·7
	522·2	—	—
	522·4	—	—
Average ..	522·3		

It was found that an increase in length of 0·07in. had been caused by the overstrain—original length of 129·25in. If l, d, C, T are the length, diameter, modulus of rigidity, and period before overstrain, and δl, δd, δC, δT the increments in these quantities caused by overstrain, then :—

$$\frac{\delta l}{l} = 0{\cdot}000541$$

$$\frac{\delta d}{d} = -0{\cdot}000270 \text{ (assuming volume constant)}$$

and

$$\frac{\delta T}{T} = 0{\cdot}004595.$$

Then since C varies as $\frac{l}{d^4 T^2}$

$$\frac{\delta C}{C} = \frac{\delta l}{l} - 4\frac{\delta d}{d} - 2\frac{\delta T}{T}$$

$$= 0{\cdot}000541 - 0{\cdot}001080 - 0{\cdot}00919 = -0{\cdot}0075,$$

i.e., the modulus appears to be reduced by 0·75 per cent.

The results of Professor Cook's experiments agree with the writer's experiments, in showing that a small decrease in the modulus occurs when the original material has been subjected to definite non-elastic strain and is then examined in regard to hysteresis after being brought into a cyclic state. The magnitude of the change is not sufficient to make it of importance in the normal service of laminated springs and engine valve springs, but in accurate calibrated loading springs it may be necessary to consider it. Presumably, when a material has been brought into a condition in which it exhibits elastic hysteresis, no further changes in the modulus are likely to occur with a given stress cycle continuously applied. Accordingly, if the material is brought into this condition by submitting it to a number of cycles to remove any initial transient hysteresis, then the chord moduli should remain constant for any particular ranges of stress, provided the superior limits and ranges of the applied stresses do not exceed those used in removing the transient hysteresis.

EFFECT OF REST AND MILD HEAT TREATMENT.

In view of the many observations which have been made on the effect of rest and mild heat treatment on the stress strain relationships of various steels,[6] a few remarks on this subject in regard to spring steels may be of value. It must be stated, however, that actual experimental evidence on spring steels is small, and accordingly the following remarks are of a tentative nature. It has been suggested by one leading authority on the subject that the state of elastic hysteresis in steels should be unaffected by rest, and although the writer does not necessarily agree with this view, there seems little doubt that any changes in elastic hysteresis in spring steel produced by rest would either be nil or so small as to be negligible. This view is based on the experiments on torsional hysteresis previously quoted. It appears, however, from hysteresis experiments by various workers that when a steel has been brought into a cyclic condition —which may or may not be such that the hysteresis is elastic hysteresis—then rest, or mild heat treatment such as boiling in water, or annealing at a low temperature, tends to restore the material to its initial condition. With stress cycles which approximate in value to the limiting safe stress ranges which can be applied there is difficulty in distinguishing elastic hysteresis from slight non-elastic hysteresis, and, in the view of the writer, a mild heat treatment may have a temporary effect on a spring steel in which the application of safe ranges of stress has caused the hysteresis to be elastic. The mild heat treatment would tend to produce slightly larger unclosed loops, together with slight permanent set when the material was again subjected to the stress cycles which had produced elastic hysteresis before the treatment was carried out. The material would then return to the previous condition in which it exhibited elastic hysteresis if the stress cycles were continued. Accordingly, when a spring has been brought to a condition in which the hysteresis is elastic by the application of safe ranges of stress, there appears to be no practical advantage in subjecting the material to a mild heat treatment.

When a spring has been subjected to unsafe ranges of stress, however, the effect of rest and mild heat treatment may be beneficial in prolonging the life of the spring. Again, the experimental evidence on spring steels is small, but for most steels it appears that when the material has been subjected to unsafe ranges of stress then rest or mild heat treatment tends to restore it to its original condition. Recent American experiments on carbon spring steels show similar behaviour.[7] It was found that the hysteresis diminished rapidly during the first few cycles of an unsafe stress range. A rest of three days caused a marked increase in the loops, followed by a decrease in width until a condition was reached which was approximately the same as that before resting. Presumably mild heat treatment would have a similar but more marked effect. It appears, then, that provided a fatigue crack in the material has not actually been started, rest or mild heat treatment of a spring would have a beneficial effect in helping to remove the effects of previous cycles of overstress. The effects of rest at atmospheric temperature or boiling in water would probably be very small on normal spring steels. It should also be realised that in a spring subjected to repeated loadings the mild heat treatment would probably give rise to slight additional permanent set when the spring was again subjected to the stress cycles. Any reheating should, of course, be below the original tempering temperature of the spring if definite softening is to be avoided.

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[3] "Torsional Fatigue Tests on Spring Steels," Department of Scientific and Industrial Research, Engineering Research Special Report No. 9, H.M. Stationery Office, 1928.

[4] "The Elastic Limits of Iron and Steel under Cyclical Variations of Stress," L. Bairstow, "Phil. Trans.," R.S., Vol. 210, 1910.

[5] "Transactions" of the Faraday Society, Vol. 24, 1928, page 125, 137. See also the following books :—

"The Fatigue of Metals," by H. J. Gough, published by Scott, Greenwood and Son, 1924.

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Cohesion.

By R. DOUGLAS ARCHIBALD, D.Sc.

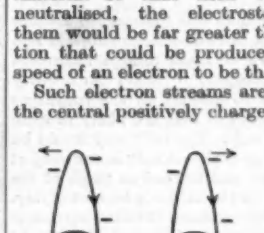
THE cohesion of solids is a question of prime importance to engineers, yet it is a matter which receives but scant attention in text-books and little or no attempt at explanation. The usual answer of the physicist is that the cause is unknown, or that the theory of relativity is necessary to explain it.

It would, therefore, appear presumptuous for anyone not versed in the highest branches of physics to approach the subject without caution, least of all attempt a theory. In such circumstances, it is usual for engineers to seek explanation from analogy, and it then becomes a question of what analogue is at the same time most suitable and least dangerous. Now there exists a close analogy between mechanical breakdown and electro-magnetic breakdown, which, if not without limits, has the merit that it can be applied to the molecular structure. A common example of electro-magnetic breakdown in practice is the stalling of an induction motor, but a better one for our purpose is the overloading of a synchronous motor, whereby the rotor is pulled out of phase to such an extent that it stops down. This is analogous to stretching a test piece to the point of rupture, the phase angle between the rotor poles and the armature field of the synchronous motor corresponding to elongation of the test piece. In both cases the mechanical reaction increases until breakdown occurs. The asynchronous motor analogy is slightly complicated by the slipping of the rotor, but we can overcome this by supposing the resistance of the rotor winding to be zero, in which case no slip could occur until breakdown. Loading the rotor would now merely cause it to fall behind the rotating field of the stator by some phase angle, as in the synchronous motor. The lagging of the rotor with load increases the distance between the rotor and stator poles and eventually causes breakdown; but, initially, the forces between the poles increase with separation, for the action of Lenz's Law sets up synchronising currents which virtually increase the pole strengths so as more than to counteract the effect of increased distance.

A similar breakdown would be demonstrable between two coaxial attracting coils in close proximity carrying direct current if the coils were drawn apart at right angles to their axis. If we further supposed the coils to have similar static charges and no ohmic resistance, we could imagine them in a state of equilibrium, facing each other a short distance apart acted on by a magnetic force of attraction due to perpetual currents in the coils, and an equal and opposite electrostatic force of repulsion. Any attempt to pull such coils apart along their common axis would at first be resisted, for Lenz's law would act so as to increase the current in the coils and maintain the magnetic force, whilst the electrostatic force would rapidly decrease with distance apart. The net result would be an attractive force varying more or less proportionally to the increased separation of the coils. Eventually, this proportion would be reduced to zero by the weakening of the mutual inductance between the coils and breakdown would take place.

Although these coils virtually consist of two circular streams of electrons moving in parallel paths, they would not normally have any electric charge, for the electron charges are neutralised by the proton charges in the body of the conducting material. On the other hand, if we supposed such electron streams to exist apart from any conducting material so that their charges were no longer neutralised, the electrostatic repulsion between them would be far greater than any magnetic attraction that could be produced, assuming the limit of speed of an electron to be that of light.

Such electron streams are supposed to exist round the central positively charged protons which form the nuclei of atoms, and in this case they do not exhibit electrostatic repulsion, since their charges are neutralised by the relatively close protons. Assuming the orbits of the electrons in each atom are more or less parallel, each atom will form a small magnet and neighbouring atoms will tend to group themselves together in closed magnetic chains. They will be prevented from making actual contact with one another by electrostatic forces, for when two atoms are so close that their distance apart is comparable with the distance between a proton nucleus and its attendant electrons, there will be a resultant repulsion between adjacent nuclei and adjacent electron streams as indicated by the arrows in the accompanying figure.



Such chains are supposed to exist in the molecular theory of magnetism, but our knowledge of this subject is at present insufficient to enable us to say whether the links consist of atoms alone, or coherent groups of atoms. The theory appears to suggest

the existence of primary magnetic chains with strong magnetic links and secondary chains with weak magnetic links. We could, then, imagine solid cohesion as due to the interlinking of primary chains which are capable of being ruptured by mechanical force or by heat, but not by any magnetic force at our command. The weak secondary chains would be present in magnetic substances such as iron, nickel, &c. These would play a very small part in aiding cohesion and would be readily disrupted and re-arranged by magnetic forces. The links of these chains may be supposed to consist of atoms grouped in such a way that resultant magnetism is produced, though much weaker than that produced by a single atom or single link of a primary chain, which need not be assumed to consist necessarily of one atom. Fusion would be the breaking down of the primary chains by heat and would take place at the temperature at which vibration of the links is sufficient to rend them apart.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

FOREIGN TONGUES.

Sir,—May I, as a reader of The Engineer, and a technical translator by profession, be allowed to say a few words on the subject of languages and language study as applied to engineering ?

Speaking from more than twenty years' experience, I think I am right in saying that the greatest obstacle to the study of foreign languages, from a commercial and technical standpoint, is the apathy displayed by manufacturers in this country to the importance of language knowledge, and the inadequate reward offered for years of hard work. Except in a few rare cases, the study of foreign languages is a subject by itself, and in order to get a really good grasp of technical French, German and, say, Spanish, as much hard work and perseverance are required as are necessary for obtaining a technical degree at one of the universities. One has only to take a foreign text-book and try to read it through to appreciate what a vast command of technical terms and phrases is needed to read and understand the whole book.

And the rewards ? Not so long ago, one large firm of machine tool manufacturers offered me £200 a year for corresponding in five languages—and I was supposed to have a full knowledge of the technical expressions used in machine tool manufacture ! Another large engineering firm in Yorkshire offered slightly more for a knowledge of four languages. And yet I have put one-third of a lifetime into language study and translating, can translate articles from the leading French, German and Italian technical journals, so that they are sufficiently intelligible to the engineer, and can carry on a running conversation with French or German engineers on some technical subjects.

Manufacturers in this country actually carrying out or contemplating an export trade lay too much stress on the social status of their export managers, and too little on their linguistic qualifications or technical training. I have known cases in which the man at the head of the export department possessed a university degree, and was strong in sports, but who could only converse in the most elementary French or Spanish, and did not know the French for "connecting-rod." Of the business methods, habits or psychology of his potential customers he knew nothing. As in many other similar cases, the figure-head was unproductive and got the big salary, while the man under him who really knew and did the work was badly underpaid.

In my view, it is impossible in one lifetime, to acquire a sound engineering training in two or three subjects and at the same time learn two or more foreign languages thoroughly—and, by thoroughly, I mean sufficiently well to enable the engineer to discuss, in the languages involved, any of the technicalities that are likely to arise in a business and technical talk. The only way would be for the potential engineer to specialise closely in one subject and in one or two languages, and to read as much of the foreign literature as he can in the subjects he is studying. The Diesel engine expert, for instance, if called upon one day to deal with, say, compressed air machinery, would find his existing vocabulary wholly inadequate for the purpose. To take another instance—electrical engineering. At a conservative estimate, anything from 10,000 to 20,000 words are required to cover the subject properly, and to learn the most important of these terms so that they are readily available for writing or conversation in, say, two foreign languages, would involve two or three years' continuous study.

The best possible method in any engineering concern doing foreign trade would be to employ a competent translator, working in close co-operation with the designs and engineering staff, and to pay the translator at least as much as the head draughtsman receives, and not treat him as a mere clerk. Such co-operation would prevent many of the stupid mistakes which are made when dealing with foreign engineering correspondence.

Finally, the professional technical translator should have some status, just as the professional engineer, the solicitor, or the accountant has, and his reward should be commensurate with the years of hard work and study which he devotes to his subject. The really efficient technical translator must know something about many engineering subjects, must be able to go through a technical article and understand it without too much searching in the dictionary—and even supply equivalents for the many new words which are being coined every year and which are not included in dictionaries—and be capable of translating simple engineering specifications into the foreign language or languages in which he has specialised. Such efficiency is not acquired in even ten years.

Edward S. Hodgson.

North Shields, August 9th.

ELECTRICITY TARIFFS.

Sir,—The leading article in your issue of the 1st inst. affords an opportunity to ventilate a subject which is of importance to nearly everybody. It indicates that this question is not being approached in a way that is likely to bring content to the great majority of electricity users. The Committee is not apparently consulting the users, who are, after all, one of the two principal parties to any sale of electricity.

I am a user, I also make electricity in large quantities. I know the cost and I have a grievance at this moment, and as it is illustrative of the difficulties to be overcome, I am writing this letter as I believe the case is helpful to a satisfactory solution. I have a large house and garden. My rateable value is, therefore, high, and, presumably, by fixed charge on the Committee's floorage basis, would be high too. There are, however, few of us living in the house and we are away abroad for long periods. The Council has a flat rate of 7d. for light and a sliding and a fixed rate for heat and power. The former only applies, however, under certain conditions as to quantity of apparatus. Although user entitles me to the lowest rate on the sliding scale, I cannot benefit because, I am told, I have not sufficient apparatus.

When electricity is used for heat and power and in considerable quantities, the only equitable basis for the fixed charge is the maximum demand steady for, say, 15 minutes. The electricity should be charged on a sliding scale per unit, varying from 2d. to ½d., including the fixed charge according to the quantity used. An amount should be fixed above which the fixed charge is not made and when the maximum demand indicator may be dispensed with. A rent should be charged for this indicator, where it is required ; but an effort should be made to encourage users to pay the minimum amount necessary to dispense with it.

It is recognised that electricity can be profitably supplied on such a basis even if there were no demand for lighting current at all. On what equitable basis then can a heat and power user be charged an extra rate for his lighting current ? He has already amply covered the annual charge on his service connection. Small users, for lighting only, must undoubtedly contribute a higher rate per unit, to cover service connection, meter rent, and user over only a short period of time, and as a contribution to overheads. But a 7d. rate is, I submit, exorbitant and ought to be obsolete in 1930. As compared with newspapers and milk, which have to be distributed daily, electric current is actually distributed cheaply.

Now, Sir, what would the public think if it were suggested that although the *Daily Mail* is 1d. at the bookshop, efficient service was rendered if it were delivered to the door at a charge of 7d. ? The difference between the wholesale and the retail price of milk is regrettably large, and the subject of controversy, but it sinks into insignificance compared with the 600 per cent. added to the cost, by some councils, for the distribution of their electrical energy.

Practical people know the costs, they know the inefficiency of public undertakings ; they are overrated and fed to the teeth. A new general tariff should be simple, progressive and, above all, moderate, demanding efficiency. Electricity to-day should be bought in bulk for 1d., or less, and sold retail on a sliding scale based on a maximum statutory charge of 2d. per unit. Accomplish this, and it is not impossible that the electrical industry will boom all over the country.

August 9th. C. B. N.

LOCOMOTIVE No. 10,000.

Sir,—One is very glad to hear that "No. 10,000" promises to be a success. It would be extremely interesting to see what would be the effect of smoothing one of the ordinary engines. The experiment could be made without serious expense and trouble, now that the method has been worked out.

From formulæ to be found in my book, "The Resistance of Express Trains," it can be shown that at the highest speeds the air resistance of the engine is of the order of 25 per cent. of the total resistance of the train.

I have thought of a further advantage to be gained by making the tender the same section as the carriages and covering up the coal with lids. One of the features of rail as compared with road travel is the dirt which is encountered on a long train journey. This dirt is not by any means entirely the outcome of the chimney. A good deal of it is coal dust blown off the tender. In fact, I have seen it stated that in France, and other places where very dusty coal is used, it is a well recognised source of loss.

It is mitigated, to some extent, by watering, but this does not affect much more than the surface, which is continually changing and being shaken down by vibration and shovelling.

Guildford, August 11th. C. F. Dendy Marshall.

ROCK DRILLING IN COLOMBO HARBOUR.

Sir,—With reference to the article headed "Rock Drilling in Colombo Harbour," appearing on page 640 of June 6th, 1930, issue of The Engineer, I have the honour to point out that the statement made as regards the depth of water in Colombo Harbour is most misleading and incorrect. Of the total area of 643 acres—

186 acres are 36ft. and over ;
102 acres are between 33ft. and 36ft.;
147 acres are between 30ft. and 33ft.;
208 acres are less than 30ft.

The rock to be dealt with varies between 25ft. and 36ft. below L.W.O.S.T., being outcrops above dredging depth of an isolated nature.

I shall be glad if you can have this mistake corrected.

G. W. Dodds, Harbour Engineer.

Colombo, July 18th.

The Formation and Properties of Boiler Scale.

The Department of Engineering Research of the University of Michigan at Ann Arbor has recently been engaged in compiling a complete review of the information available up to the present time concerning the formation and the properties of boiler scale. It has now published a bulletin setting out the results of its labours, and has, very courteously, sent us a copy of it. The publication deals :—(*a*) with the effects of scale on boiler efficiency and boiler metal temperature ; (*b*) with the chemical and crystallographic determination of scale constituents ; (*c*) with the respective solubilities of these constituents, and the possibility of calculating solubility equilibria in complex solutions ; and (*d*) with the method and rate of formation of scale. It concludes with a summary of contemporary methods of scale prevention. In addition, there are four appendices, entitled, respectively, (1) Scale-Formation in an Experimental Boiler ; (2) The Crystal Forms of Calcium Sulphate ; (3) The Solubilities of the Crystal Forms of Calcium Sulphate ; and (4) A Photomicrographic Study of Scale Formation.

The General Summary of the Conclusions arrived at as the result of the inquiry is as follows :—

"The safe and efficient operation of boilers at the high ratings customary at the present time requires the complete prevention of boiler scale. Scale is a heat-insulating material, and, contrary to common impression, porous scales are poorer conductors of heat than dense scales. A very slight deposit of even a hard dense scale may, however, cause the overheating and failure of boiler tubes exposed to direct radiation. The overheating of boiler metal is the most serious effect of scale ; its effect on overall boiler efficiency is much less than the figures commonly quoted.

"The chief chemical constituents of boiler scale are calcium sulphate, calcium carbonate, magnesium hydroxide and calcium and magnesium silicates. Calcium hydroxide is occasionally found as a major constituent, and various other substances are also found in scales formed under unusual conditions. All of the chief constituents of scale are very slightly soluble in water at boiler temperatures, and all of them are believed to become less soluble with increase in temperature. It has been shown by direct measurement that calcium sulphate, calcium hydroxide and magnesium hydroxide all decrease in solubility as the temperature is raised in the boiler range. The solubility of calcium carbonate is dependent upon the concentration of carbon dioxide in the atmosphere in contact with the solution, but it has been shown at lower temperatures that, for a constant partial pressure of carbon dioxide, the solubility of calcium carbonate also decreases with temperature increase. While there are no definite data for the calcium and magnesium silicates, it is believed that they show the same property of negative solubility slopes.

"Sludge and scale formed in a boiler must be in approximate chemical equilibrium with the complex solution represented by the boiler water. In dealing with solubility equilibria in these complex solutions it is probably preferable to make calculations from the viewpoint of activities rather than attempting to use data for ionization of the respective substances in their respective simple solutions in pure water.

"Boiler scale may conceivably be deposited in three ways : By the settling out and subsequent cementing on the boiler surfaces of articles suspended in the water ; by spontaneous crystallization of salts from super-saturated boiler water, the action taking place chiefly at the heating surfaces of the boiler because of the greater degree of super-saturation caused by decreased solubility of scale constituents at the slightly elevated temperature in the fluid film adjacent to these surfaces ; and by the action of bubble evolution at an evaporative surface, the scale crystals being deposited in rings formed by the line of contact of the bubbles with the dry surface beneath them and the solution around them. The first type of scale formation may actually take place in an intermittently operated horizontal return tubular or marine boiler, but is certainly not responsible for the formation of scale in the tubes of water-tube boilers. Here, the third type of action undoubtedly occurs. The deposition of scale on surfaces at which evaporation is not occurring must be due to a mechanism of the second type described.

"The rate of scale formation in a boiler is probably not a function of the actual solubility of the scaling substances, but rather of their rate of decrease in solubility with increase in temperature. The other controlling factor is the rate of heat transfer across the surface on which the scale is growing, while the velocity of the boiler water may have a slight influence.

"The prevention of scale depends upon either extremely complete softening of feed water, or careful control of the chemical equilibria in the boiler water to precipitate as solid material a substance which will form scale only with extreme slowness, if at all. For external softening, the hot-process lime-soda, lime-barium, and either lime-zeolite or zeolite-acid systems are the most important at the present time. Internal conditioning with soda ash is limited to lower pressures because of the high alkalinity developed in the boiler water by hydrolysis of carbonate, but phosphate conditioning is applicable at

any pressure, particularly when used in conjunction with some types of external softening treatment. While colloids undoubtedly exert an influence on the physical properties of scale, reliance should not be placed on their use for scale prevention in boilers where slight scaling might cause failure. Electrical systems of scale prevention apparently have little actual value.

"*Need for further research on scale problems.*—Boiler scale is not a problem which has been satisfactorily solved once and for all. The development of boiler design is constantly rendering inadequate the means previously taken to obviate the occurrence of scale. Continued research is a very definite necessity. At present there are several lines of investigation which should be started without delay. One of these is a study of the silicate compounds formed in boiler scale, with a determination of the solubility equilibria of these substances in boiler waters at high temperatures, and an investigation of the available means for their certain prevention. Another problem of prime importance is a general study of solubility equilibria in boiler waters at temperatures up to the critical temperature.

"It is probable that for many years to come the majority of smaller boiler installations will operate at only moderate pressures. For the benefit of engineers in this field, comprehensive studies should be made of the controlling factors in the hydrolysis of carbonates, and of the effects which organic colloids do or do not produce in the inhibition of scale growth. It would also be extremely valuable to have a comprehensive engineering report on the various proposed systems of scale prevention by electrical means.

"Steam seems destined to remain one of the chief means of energy transfer for an indefinitely long future. The generation of steam, however, must always involve, at some point, the use of impure natural waters. When steam is no longer generated, boiler scale problems will have been finally solved."

South African Engineering Notes.

Inyaminga Petroleum.

INTEREST in the boring operations which have been proceeding at Inyaminga, Portuguese East Africa, for several years in the hope of striking oil, has been revived by the latest news. For a considerable time operations were held up owing to the drill being lost, but it was at last fished out and sinking resumed. It is now reported by the manager that "the oil horizon has been definitely reached at or about a depth of 2763ft. The technical adviser on the spot reports that the drill has entered a fine loose-grained sand impregnated with petroleum. It is, however, only about a yard in thickness, is capped above by a hard conglomerate, and is shut in below by a reddish clay bed." The chairman of the African and European Company, Ltd., which is largely interested in the venture, has informed the shareholders of the company that the fear in the minds of many as to the existence of oil had now been removed by the proof that oil was there in the sand, but that it was impossible to say how much deeper they would have to go either in the present hole or possibly in another bore-hole before they got to a thicker layer of sand where commercial oil was expected to be encountered. The directors felt, however, that they were on the right track to get oil at Inyaminga at an early date.

Cape Town Aerial Railway.

The Table Mountain Aerial Cableway Company, Ltd., during the first six months of its operations earned a net profit of £5071 14s. No sort of accident occurred in the working of the cableway, either to passengers or members of the staff. When the undertaking was originally contemplated it was realised that the south-east winds during the summer season would possibly interfere with the traffic, but although the number of days on which there were strong winds was, during the six months, up to, if not over, the average, there were only eleven days on which the service had to be suspended. Not until the cableway has run for a full year will it be possible to form a reliable estimate as to what the returns will be. The indications are that they will be quite satisfactory.

Buffalo Harbour Works.

A sum of £249,000 is to be spent on wharves, sheds, cranes, and the deepening of the entrance channel to the—East London—Buffalo harbour. In addition, an amount of £32,000 is to be spent on the turning basin, which, when completed, will allow the largest ships that visit South African waters to enter the port and tie up against the wharves. The Harbour Administration also proposes to purchase an ocean-going tug for Buffalo Harbour. The present tugs, although well suited to ordinary harbour work, are totally inadequate when called upon to go out in stormy weather to render aid to ships in difficulties, so that the addition of this tug to the harbour equipment will constitute a further step towards safeguarding ships when proceeding round the coast, in addition to being a distinct asset to the harbour.

Record Gold Output.

The gold production for the month of May was 916,213 oz., obtained from 2,741,634 tons of ore, which compares with a tonnage of 2,594,250 tons for April last. The total revenue was £3,851,584, compared with £3,647,673. The total revenue is therefore £203,906 over that for the shorter month, but the revenue per ton at 22s. 1d. is 6d. lower. There was a reduction of 5d. per ton in working costs—19s. 8d. as against 20s. 1d.—with the result that the profit per ton was 8s. 5d., as compared with 8s. 6d. for April. The total profit for May was £1,153,549, an increase of £69,045.

New South African Industry.

For the purpose of providing the Pretoria Municipality with additional water a supply is to be taken from the Rietvlei, which will involve the use of over 11 miles of piping. For a portion of the undertaking the product of a new South African industry, viz., the Hume steel electrically welded pipe, is to be employed. The water scheme has been divided up into three sections; for section one alternative tenders were invited for the supply of reinforced concrete or steel piping, and an interesting feature in connection with that section is that the Board of Engineers specified an internal diameter for steel pipes of 36in., whereas for reinforced concrete pipes the internal diameter specified was only 33in. The length of piping involved in section No. 1 is just over 8 miles, and reinforced concrete has been decided upon. For section No. 2 over 13,000ft. of 24in. diameter steel pipe was specified, and for section No. 3 nearly 4000ft. of 12in. The Hume Pipe Company (South Africa), Ltd., was the successful tenderer for the supply and laying of all three sections. The Hume steel electrically welded pipe is made of imported steel plate, which is cut and bent into shape and subsequently welded by a new automatic electric arc welding process. The steel pipes, both 12in. and 24in. diameter, are to be lined with concrete, and it is after this lining has been done that the diameter will be as above stated. A new factory has been erected adjacent to the Hume Pipe Works at Germiston, and a new company, which has been formed under the name of Hume Steel South Africa (Proprietary), Ltd., to exploit this new process, will be under the control and management of the Hume Pipe Company (South Africa), Ltd.

Witwatersrand Factories.

There are now 1600 factories in the Witwatersrand area, of which 300 belong to engineers or those whose trades bring them into the same official classification. The total average number of employees in these factories is 19,000, and they draw approximately £2,245,000 annually in salaries and wages. The material used is valued approximately at £2,750,000, and it includes about £400,000 worth of South African iron and steel. More workers and more South African raw material are being absorbed by the engineering industry year after year.

Railway Workshops.

An expenditure of £105,000 has been sanctioned by the South African Railways Department for the erection of a blacksmiths' shop and foundry in the railway works at Bloemfontein. This sum will be in addition to £275,000 voted last year for the expansion of the local railway works, which are making rapid headway towards completion. The construction of the blacksmiths' shop and foundry will not, however, be begun for some time, pending the completion of new works at present in hand.

Third Largest Telescope.

The third largest telescope in the world and the largest in the Southern Hemisphere recently arrived at the observatory at Mazelspoort, near Bloemfontein. The instrument, it is understood, will be ready for work in about a year. The whole installation, without the reflecting mirror, weighs 27 tons and the axle alone 24 tons. The Havard Observatory will soon be able to do all its work there. Bloemfontein will now assume great importance in the astronomical world with this giant reflecting telescope, and the observatory will be one of the most modern in its equipment in the world.

Rail Cars on S.A.R.

The Railway Administration, in its efforts to decrease branch line cost, has been experimenting with rail cars designed to take the place of trains in certain sections of the country. The Administration is trying various types of self-propelled vehicles, including cars driven by electricity and by internal combustion engines consuming petrol or crude oil. The cars are built to carry about thirty passengers and are not unlike a big motor omnibus or tramcar in appearance. The chief difficulty, however, in the experiments which have already been conducted over a long period on country branch lines has been to evolve a type of vehicle which is strong enough for the rough work to which it must be submitted. Varying reports have been received from branch lines on which the rail cars have been tried. Some have been successful and others failures.

Pulverised Fuel at Sea—The "Incemore" Installation.

IN our issue of July 19th, 1929, we gave particulars of the installation of the Todd unit system of pulverised fuel burning, on the American cargo steamer "West Alsek," which ship has, we learn, continued to give excellent results in service. On Thursday of last week, August 7th, a demonstration trial took place at Blackwall Dock on the Johnson Line steamer "Incemore," belonging to Furness, Withy and Co., Ltd., which has recently been equipped with the Todd unit system by R. and H. Green and Silley Weir, Ltd., under the supervision of Mr. W. E. Keller, the representative in this country of the Todd Dry Dock and Engineering Company.

The steamer "Incemore" has a length of 360ft. with a gross tonnage of about 4100, and she is propelled by triple-expansion engines taking steam from three three-furnace cylindrical boilers.

New Pulverised Fuel Plant.—The pulverised coal-burning plant, recently installed, consists of three Todd triplex pulverisers and burners fitted to each boiler, which operate in conjunction with the existing Howden forced draught furnace fronts. A coal-crusher has also been installed in order that bunkers may be taken in at any desired port. The arrangement of the pulverising plant in the stokehold was designed so as to be carried out with the minimum of alteration to the ship's structure and piping.

The structural alterations to the vessel necessary for the installation consisted chiefly of partially dismantling the water-tight bulkhead at the forward end of the stokehold, re-erecting it five frame steps further forward, and carrying the new bulkhead up to the main deck. As the vessel is fitted with two deep tanks at the port and starboard sides immediately forward of the stokehold, it was only necessary to fit fore and aft bulkheads between the lower and upper 'tween decks to complete the water-tight division to classification requirements. This allowed an available space of 15ft. by 11ft. for installing the pulverisers, which has proved ample for the purpose.

The space immediately above the recess, which extends to the upper 'tween deck, has formed a bin for crushed coal, from which the pulverisers are supplied. A recess has been built into this daily supply bin, on the deck of which has been placed the primary crusher. The daily supply bin is fed with coal from the upper and lower 'tween decks, through four ¾in. mesh grizzlies, while a 6in. mesh grizzly has also been fitted for feeding "run of mine" coal to the crusher and discharging to the lower part of the daily supply bin. No elevators or screw conveyors were fitted, as the position of the ship's bunkers made it possible to dispense with their use by installing the above arrangement.

The new pulverisers are a development of the original Todd system of unit pulverisers for each furnace. In this particular instance, as the boilers to be fired were of the three-furnace type, it was decided to embody three separate pulverisers in one casing, thereby forming a single unit for each boiler. The pulverisers are of the high-speed impact type, each pulveriser having two stages of pulverisation. The first stage beaters have a clearance of approximately ¾in. between themselves and the casing, and the second stage beaters have a clearance of only ¾in. The coal, after passing the two stages, enters a fan which discharges it in a pulverised form direct to the furnaces through a flexible metallic hose connection. The fan is mounted on the same shaft as the two stages of the pulveriser and embodied in the same unit. The pulverisers are driven by direct-coupled steam turbines and run at a speed of approximately 3600 r.p.m.

The coal is fed in a crushed form to a small hopper mounted on the top of the unit. From the hopper it falls by gravity on to a horizontal revolving table, and three scraper-knives equally placed around the circumference of the table feed the coal to the three independent pulverisers in each of the units, thereby giving equal distribution to the three furnaces. Between the feed hopper and the revolving table there is an adjustable sleeve, which, when raised or lowered, alters the angle of repose of the coal on the revolving table and increases or decreases the rate of feed in accordance with the steam demand. The revolving table is driven by a small half horse-power electric motor, which enables the feed to be instantaneously stopped by switching off the motor without touching the steam control of the turbine driving the pulverising unit.

Under reduced loads, such as manœuvring, or in port, provision is made to shut off the supply entirely from one or more of the mills.

The "Incemore" is the first British vessel to be fitted with the Todd unit system, and she is due to leave London on August 27th. It is expected that a full report on the working of the system will be published after the ship has been in service some months.

LLOYD'S REGISTER SCHOLARSHIP AND STUDENT GRADUATE EXAMINATIONS.

THE Council of the Institute of Marine Engineers desires to make known as widely as possible amongst apprentice and junior engineers the following particulars of the examinations which are conducted annually under the auspices of the Institute.

Lloyd's Register Scholarships.—These are three in number, one being available each year for three years at £100 per year. They are offered by Lloyd's Register of Shipping. Among the regulations are the following:—

(1) The Scholarship is open for competition to candidates who are British subjects, *i.e.*, all who are of British parentage in its Imperial sense, the age limit being from 18 to 23 at the date for entering the University. Preference will be given, in the event of nearly equal marks, to the candidate who acquits himself best at the subsequent oral examination before a special committee. The successful candidate, if not already associated, must join the Institute of Marine Engineers in the grade for which he is qualified.

(2) The Scholarship is intended to assist marine engineering students to obtain an advanced course of instruction in engineering subjects. The successful candidate will be required to give an undertaking that he will enter himself as a student and take up the recognised degree course for engineering students at some approved University.

(3) The holder of the Scholarship must show satisfactory progress in his course of study at the termination of each session, in addition to which he should satisfy the Committee of Lloyd's Register as to his employment during the recess.

(4) Only those are eligible who have served at least two years in a commercial engineering workshop, and until the time of application, have been employed in engineering either ashore, afloat or at college, with the intention of entering upon the profession of marine engineering.

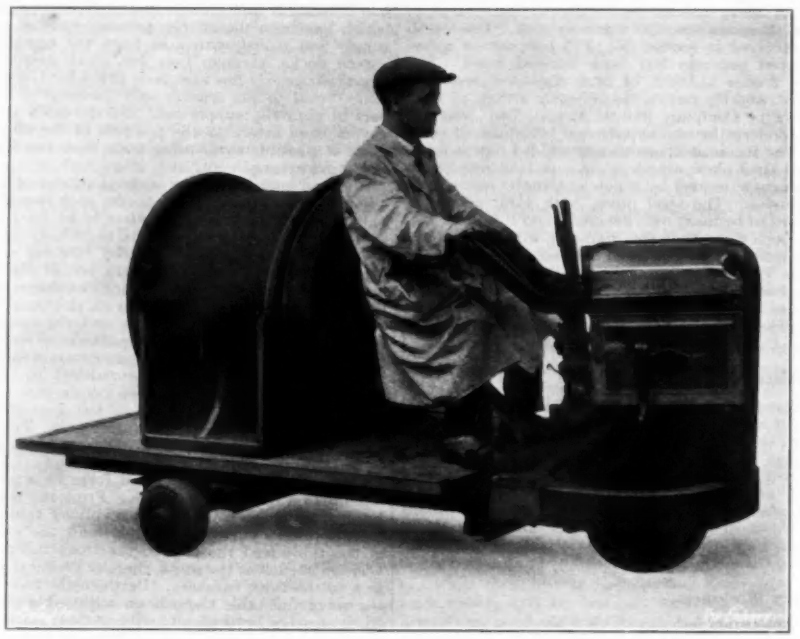
(6) The Scholarship, the conditions attached to it, and the continuation of it, are entirely reserved in the hands of Lloyd's Register, which may alter the terms from time to time, on six months' notice prior to the date appointed for the examination.

Student Graduate Examination.—Engineer apprentices and/or students who have completed one year of their training are eligible as candidates for Student Graduateship of the Institute. Candidates must obtain at least 50 per cent. of the possible marks for a "pass," and must pass in all the subjects set in order to qualify for election as a Student Graduate. Those who fail in any subject may apply again the next year for examination in that subject only, in order to complete the requirements for election. The examination papers will be based upon the lower stage syllabus issued by the Board of Education for the respective subjects. An award or awards will be given in the event of the examination being passed with a high degree of credit.

Further information regarding these scholarships and examinations, and copies of previous papers, may be obtained on application to B. C. Curling, secretary, the Institute of Marine Engineers, 85–88, The Minories, London, E.C. 3.

1-TON PETROL-DRIVEN FACTORY TRUCK

BRETT'S PATENT LIFTER COMPANY LTD., COVENTRY, ENGINEERS



A New Form of Factory Truck.

On the occasion of a recent visit we inspected at work a new form of run-about truck for factory transport, and such-like services, which is being produced by Brett's Patent Lifter Company, of Foleshill Works, Coventry, and is generally illustrated above. It is driven by a petrol engine, and, as will be seen from the first of our engravings, is of the three-wheeled type, in which the steering and driving wheel and the motor are built up into one unit, so that the vehicle can be steered in any direction and even reversed without interfering with the running of the engine.

To this extent the machine is not altogether novel, but it embodies several special features that should make it appeal to engineers. It is nominally of 1-ton carrying capacity, but will, we are told, safely take a load of 30 cwt. up a gradient of 1 in 6, and will, as we assured ourselves, go over very rough ground without dislodging its load.

The engine is a standard two-cylinder, horizontally opposed, air-cooled petrol set of 4½ horse-power, which is plainly shown in Fig. 1, mounted in the upper part of an angle iron framing. The drive is taken from the engine crank shaft to a countershaft mounted in a bracket in the front, by means of a roller chain, and then by another chain to a sprocket bolted to the front driving wheel. The engine and the countershaft bracket are mounted on turned rods fixed in the main framing, so that their distance may be adjusted to take up any slackness in the first driving chain. The total ratio of this chain gearing is 16 to 1. On the countershaft there is a multiple plate clutch for transmitting the drive from one chain sprocket to the other. This clutch is operated by a connection through the hollow countershaft and the bell crank lever seen on the left in Fig. 1. This crank is connected with a bar arranged just below, and parallel with, the steering handle of the vehicle. When the driver grips the steering handle he also grips the clutch operating bar, and thus puts the clutch into engagement, where it may be held by a catch. If the grip on the bar is released the clutch first drops out of engagement, and then the magneto ignition of the engine is short circuited, so that the engine stops. In other words, if the driver relaxes his hold on the steering handle, the vehicle automatically stops.

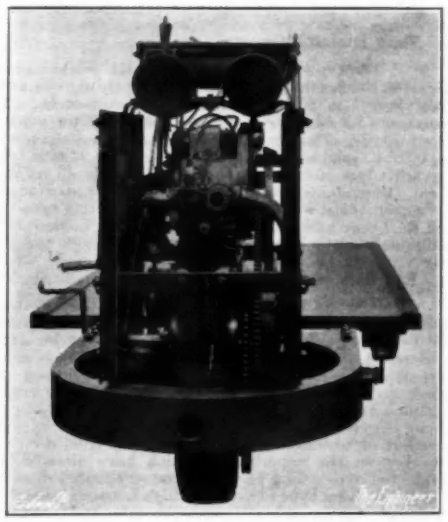


FIG. 1—POWER UNIT OF TRUCK

The whole of this unit, comprising the engine, transmission gear, supply tanks and driving wheel, is mounted within a framing, and this framing is connected with that of the truck itself in a rather ingenious manner, which is illustrated by Figs. 2 and 3.

As will be seen from Fig. 2, the front wheel is embraced by a horizontal, ring-shaped casting that is attached to the framing of the chassis. This ring is of channel form in cross section, and is machined on its two flanges. Within this casting there is another ring on which the power unit is based. The inner ring must, of course, be capable of revolution within the outer ring, for the purposes of steering, so the connection between the two is made by means of a series of four pairs of roller bearing pads.

These pads—see Fig. 3—are mutually pivoted on to the base ring of the power unit frame by the large bolt seen in the centre of the engraving. The shoe of each pad is provided with three rollers that bear on the inside faces of the embracing ring, and thus transmit the upwards or downwards load from the chassis to the wheel frame. The two pads are free to oscillate about the central bolt, but are restrained by the two springs shown.

In explanation of this arrangement of rollers, which at first sight appears to be rather elaborate as compared with, say, an ordinary turntable, it should be pointed out that the front of one of these three-wheeled trucks is subjected to very considerable racking stresses in service, so that the pressure on any individual bearing may momentarily be upwards or downwards. Simple rollers will not satisfactorily meet these requirements as they might tend in some circumstances just to rub round in the ring without rotating at all. By using two sets of rollers in separate pads that possibility is entirely avoided, while the spring arrangement allows the rollers to ride over any dirt which may accumulate in the ring. The play provided by the spring is approximately $^{1}/_{32}$in.

The spring suspension of the vehicle is effected at the back wheels by simple laminated springs. The front wheel—see Fig. 2—is mounted between the two arms of a pivoted U frame. At the rear of this frame there are two coiled springs to carry the load, while two others—plainly seen in the illustration—act to check any rebound. There are brakes on the back wheels, operated from a pedal in front of the driver's seat, that are used in normal driving; but there is also another brake on the front wheel, which can be used should the driver have to leave his seat and turn the power unit round to go astern.

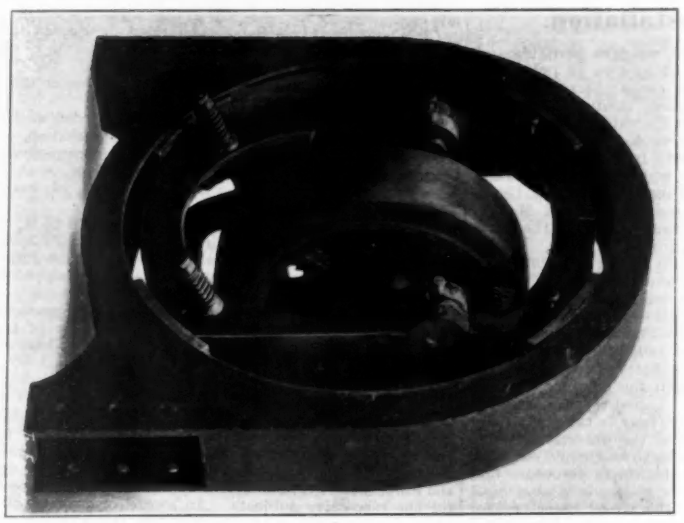


FIG. 2—DRIVING WHEEL AND FRAMING

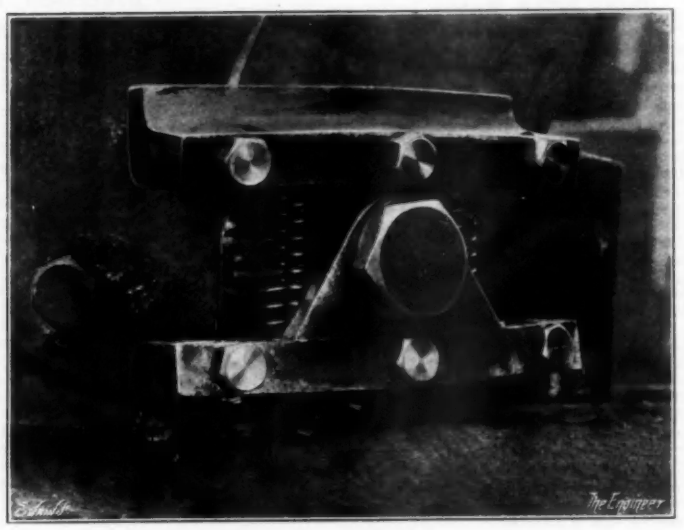


FIG. 3—TRIPLE-ROLLER BEARING PADS

Land Reclamation and Irrigation Works in Italy.

The first section of one of the largest irrigation works in Europe was formally put into service in Italy on July 20th by the Italian Minister of Agriculture. The scheme utilises the waters of the Po to fertilise 220,000 acres of land in the provinces of Reggio Emilia and Modena. Ten years ago the district, which lies between two tributaries of the Po, the Crostolo and the Secchia, largely consisted of swamps, rendered valueless by stagnant water with no natural outlet, left behind by the frequent floods of the two torrents. Soon after the War the landowners formed an association to reclaim the whole area. The work has been carried out at a cost of 240 million lire, by erecting two pumping stations of 10,000 H.P. each, with a capacity of 100 cubic metres of water per second. The water raised by these pumping stations flows into a system of canals, the total length of which exceeds 1200 kiloms., and which intersect the area in all directions.

It was on October 28th, 1926, that Signor Mussolini, by setting in motion the pumping station at San Siro, initiated these great drainage works. Since then no fewer than 1000 new farms have started on the fertile fields reclaimed, a network of roads, some 120 kiloms. in length, has been built, a hydro-electric station of 60,000 H.P. has been erected at Dolo to provide power for the farms, over 600 houses have been built, and the wide plain that ten years ago, seen from the heights of the Parmigiana-Moglia embankment, displayed a swampy expanse overgrown with reeds and rushes, has been transformed into agricultural land held by some 12,000 landowners on which the casual farm labourer of the past is now finding permanent occupation. But to complete the work it was essential that a system of irrigation should be provided.

This further task was undertaken two years ago, in 1928, by cutting a canal communicating at Borretto with the Po, the waters of which are drawn upon to the extent of 40 cubic metres per second. The canal is controlled

by two locks arranged at 150 m. distance one from the other, enclosing a pool affording sufficient depth of water for barges of 600 tons. This pool, which will serve as a river port for the territory of Reggio Emilia, is connected up with the Reggio-Borretto railway. The canal provides the water for the ditches, which irrigate the 220,000 acres of reclaimed land, on a system remarkable for its novelty. Instead of flowing from the high lands down the valley, the water is raised from the valley to the hills by a series of twenty pumping stations. The area is divided into seven sections running parallel to the main canal. The first section lies lower than the banks of the canal and the water flows naturally into the irrigation ditches, but it is raised by one pumping station to the lands comprised in the second section, and so on, being raised at last to the seventh through a series of six pumping stations.

The cost of the water varies from 90 lire per hectare for ten irrigations per annum at the lowest level, to 320 lire at the highest level, the difference in price being accounted for by the cost of the electric power needed to raise the water. The advantage of the system is that only the quantity of water actually needed by each section is raised to the required level, whereas if the water flowed down from the main canal the whole mass would have had to be raised to the highest level, and the power needed would have been more than double what is now necessary.

As it is, the pumping stations will consume not less than 10 million kWh per annum, the energy being furnished, at special rates, to the Association by one of the hydro-electric stations of the Appenines.

The entire system will be completed and working in 1931, and its total cost will, it is stated, be 100 million lire, of which 63 per cent. will be provided by the Treasury, 12 per cent. by the province, and 35 per cent. by the associated landowners.

It is estimated that, when the potential yield of the main canal is fully utilised, the economic returns obtained from these reclaimed lands will increase by 100 million lire per annum. Live stock and dairy farming in association with vineyards will continue to be the characteristic activities of the zone, but irrigation will increase the yield of the forage crops by some 200,000 tons per annum, the 135,000 head of cattle now on the land will easily be raised to 170,000, while the output of milk will be increased from the present figure of 120,000 tons to 170,000. But the greatest benefit of all will be the social transformation made possible by this creation of wealth, which will fix a larger population on the land and gradually transform the casual labourer into a permanent farm worker, a renter and a smallholder.

The day after opening this work, the Minister of Agriculture proceeded to Sarzana to open the Lunense canal. This main canal, 22 kiloms. in length, receives 6 cubic metres of water per second from the little river Magra, to irrigate 12,000 acres in the provinces of Spezia and Massa. The water will also feed two hydro-electric stations, generating 5 million kWh per annum, which will be used for industrial purposes and for raising the irrigation waters.

Statistical data for the financial year 1929–30, recently submitted by the Under Secretary for land reclamation, to the Head of the Government, show that the cost of the reclamation works executed or authorised during that year amounted to 1122 million lire, of which 700 million lire were provided by the Treasury.

BOOKS OF REFERENCE.

The Statesman's Year Book: Statistical and Historical Annual of the States of the World for the Year 1930. By M. Epstein, M.A., Ph.D. London: Macmillan and Co., Ltd., St. Martin's-street. Price 20s. net.—Like many annual reference books received at this office, this stout little volume contains a large amount of useful information of a commercial character condensed into a very small space. Taking each country, it gives the Constitution, Government, Population, Education, Finance, Production, Industry, and Commerce. It is a valuable book of reference, and should be of especial value not alone to statesmen—if any exist in these days—but to commercial firms with international relations.

B.E.S.A. SPECIFICATIONS.

DERRICK AND TRAVELLING JIB CRANES.

The British Engineering Standards Association has just issued a revised edition of British Standard Specification No. 327, Parts 1 and 2, for Derrick Cranes, Power-driven and Hand-operated, and a new British Standard Specification No. 357 for Travelling Jib Cranes (Contractor's Type). The object of these specifications is to secure the general observance of such fundamental principles as appear desirable to ensure reliability and safety without hampering the freedom of the crane maker in his selection of the most appropriate design for the purpose in view.

The Derrick Crane Specifications provide for the Scotch derrick, the guy derrick and the tower derrick types of crane now so largely used in building operations. The factors of safety and allowable working stresses specified are applicable to cranes intended for ordinary duty, higher factors of safety and allowable working stresses being recommended for duty of greater severity, or where there is a liability to accidental overloads as in dockside, quarrying or magnet cranes, and it is interesting to note in all three specifications that timber is not permissible in any stress-bearing part of the crane structure.

Copies of these three Specifications (Nos. 327, Part 1, 327, Part 2, and 357) can be obtained from the British Engineering Standards Association, Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. each, post free.

A new discovery of a silver ore lode is reported from the southern end of Granville Lake in the Churchill district of Manitoba.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Work Resumed.

Activity has now been resumed at most of the works and factories in the Midlands and Staffordshire, though, in many cases, it was as late as the middle of this week before the wheels were set in motion. There are still establishments with closed doors, but, fortunately, there are not many. The work in hand, except in the case of a few fortunate firms, is of no great bulk, order books not having been materially added to during the holidays. This applies to almost every branch of Midland industry. No buying movement on home account is expected to develop until September, but overseas requirements will, it is hoped, enable manufacturers to keep going in the interim. There was a decidedly better attendance in Birmingham at the weekly meeting of the iron trade to-day—Thursday—and there were some small evidences of an awakening from the recent lethargy. Inquiries were in circulation for material and consumers were evidently more inclined to talk business than they have been for many weeks past. True, they cannot foresee their requirements very far ahead, but they are hopeful of an early improvement in trade. Many of them believe, and all hope, that the worst has now been reached and that the situation will shortly take a turn for the better. With that in mind they are sounding the market in an endeavour to discover whether or not iron and steel prices have reached bottom. Producers assert that they have, but consumers do not appear to be entirely satisfied on this count. It is felt that raw iron prices could be even lower and still leave a reasonable margin of profit to blast-furnacemen. Owners of furnaces in this area, however, reply that the full advantage of cheaper furnace coke has now been passed on to the user of pig iron and that nothing further in the nature of lower prices is to be looked for until the position alters very materially. Steel masters contend that their selling rates are very reasonable and that those who pledge themselves to support home production are getting their materials at favourable rates. As for those firms who buy in whichever market suits them, they must be prepared to pay for the privilege. Interest in the market is now being displayed and that in itself, after the apathy of recent weeks, is a favourable omen.

Pig Iron.

Sales of Midland brands of pig iron are said to have improved during the past week, and producers expected to book considerable orders at to-day's meeting in Birmingham. The reduction just prior to the holidays, by a further half-a-crown per ton, of raw iron values, brought native material well out of the range of foreign competition, and it only requires an increase in consumptive requirements to assure a better volume of business for Derbyshire and Northamptonshire smelters. Consumers' stocks have of late been allowed to fall to a very low level, indeed, and there are signs of a desire on the part of some ironfounders to gradually build up those stocks again. To this is attributed the reported increase in the tonnages of recent orders. Foundrymen are evidently more satisfied now that they are not being exploited by the furnacemen and much of the bitterness which has been displayed of late has disappeared, negotiations being undertaken in a very different spirit to what they were a month ago. This is, of course, all to the general good, and as soon as the autumn demand shows signs of developing some forward contracting in the raw iron department is looked for. The policy of hand-to-mouth buying persisted in so long by users has completely changed the position alike for furnacemen and foundrymen and a return to the normal manner of business will be very welcome to both parties. Producers will be enabled to get along with production in the knowledge that a certain portion of it is earmarked while foundrymen will be spared the trouble of constantly negotiating for small parcels of material required from week to week. Work at the foundries is none too brisk at date, but an early inflow of orders is anticipated and next month should witness larger orders for raw material. Everything, of course, depends upon consumers' needs, but they are considered to be more likely to increase than decrease. Stocks of iron at the furnaces are rather large, having increased considerably during the holidays while the consuming works have been idle. Prices of Midland pig irons for delivery in the zone now stand at £3 13s. 6d. for Derbyshire No. 3 foundry and £3 10s. for Northamptonshire. Forge iron for the puddling furnaces now costs £3 8s. 6d. for Derbyshire and £3 5s. for Northamptonshire.

Finished Iron.

Although in the Staffordshire finished iron trade generally the tone is dull, marked bar houses resume operations with reasonably good order books, ensuring regular rolling for some weeks to come. There has been a steady flow of orders for some months past only broken just before the holidays. There are evidences that the interruption in the flow of business was only of a temporary character, and ironmasters in the marked bar department look with some confidence to the future. Their production is all sold at the full figure of £12 10s. per ton, and so far they have seen no necessity to reduce it. It is in the medium and common bar branches of the iron trade that matters are so unsatisfactory. Makers of Crown quality bars have but few orders for execution, and new business is difficult to secure in face of severe competition from makers in other ironmaking areas. Local makers ask a minimum of £10 per ton for their product, while many firms will not sell below £10 7s. 6d. Material from outside areas can be bought at about 5s. per ton below the Staffordshire makers' minimum figure, so that the difficulty in making sales is plainly apparent. It is claimed that Crown bars of local make are superior in quality to those sold at cheaper rates, and that is the only salvation for district makers. Where quality is the first consideration, the order goes to Staffordshire, where it is a secondary consideration the order is placed outside that area. Rollers of nut and bolt bars are very badly hit by Belgian competition. Staffordshire ironmasters cannot hope for a material accession of business while there is a difference of £3 7s. 6d. per ton between their quotation and that of Belgian makers. Strip mills continue fairly well placed and values of iron tube strip are upheld at £11 2s. 6d. per ton delivered.

Steel.

There is no alteration in the steel position from that existing before the holidays. Demand continues at a low ebb, the various departments of engineering being at best only moderately employed. The rolling stock establishments in this area are probably the best consumers of steel just now. Constructional engineering firms find business quiet and unremunerative, and automobile engineers report a definite slacking in business. Light engineering firms are absorbing a fair aggregate tonnage of steel, but taken on the whole the demand is disappointing. The Association fixed prices for finished material are upheld. Angles are quoted £8 7s. 6d.; joists, £8 10s. tees, £9 7s. 6d., and ship, bridge and tank plates, £8 17s. 6d., all subject to rebate. Foreign joists are being offered in Birmingham at fairly cheap rates, but they are not finding many buyers. Half-products are the subject of intense foreign competition. Small bars for which local makers require £7 17s. 6d. upwards, are obtainable from importing merchants at £5 13s., while billets for which native producers require at least £5 17s. 6d., are offered by the foreigner at £5 5s. Midland steel mills are badly off for orders and there was some talk in Birmingham this week of firms being prepared to accept billet orders at half-a-crown per ton below the recognised minimum. This is not, by inquiries, established as a fact, however.

Galvanised Sheets.

Many galvanised sheet mills have a fair amount of work under execution, but most of them could do with more orders. Values are unaltered on the agreed basis of £11 17s. 6d. per ton for 24-gauge corrugateds. Buyers who have been waiting for lower prices are likely to be disappointed as the market for spelter now appears to be rising and sheet values will probably move upwards in sympathy. There is no improvement as yet in demand from overseas, but makers contend this cannot be much longer delayed.

Scrap.

Buying of heavy steel scrap from Birmingham merchants is almost negligible. Consumptive demand is very small owing to the shutting down of steel works in South Wales. Prices are weak and it is expected that market values will deteriorate further.

Birmingham to U.S.A.

The returns of exports from the Birmingham Consular district to the United States of America for the quarter ended June last and just published, are very disquieting, for they show an all-round reduction when compared with the corresponding quarter last year. Although the Stoke-on-Trent area is now included in this district there has been a decline in the total value of exports of no less than 335,983 dollars, or approximately 10 per cent. Were it not for the inclusion of the Stoke figures it is computed that the fall would be equivalent to, roughly, 33½ per cent. Among the most notable decreases are steel tubing from 291,026 dollars to 78,755 dollars; machinery from 202,134 to 58,249, and metal manufactures from 127,570 to 53,542. Exports of brass manufactures are down from 60,894 to 38,085, fishing tackle from 32,743 to 17,438, needles from 164,179 to 96,160, pens from 113,461 to 49,930, pins from 19,016 to 11,803, tin-plates from 9148 to 4816, and silverware—plated—from 118,198 to 79,308.

Worcester Porcelain Works Reopen.

It is stated on good authority that Worcester Royal Porcelain Works have been acquired by Mr. J. Harrison, of the Crown Ducal Works, Tunstall, Staffs. Operations at the factory have been resumed this week. It will be recalled that a fortnight ago an announcement was made that a receiver had been appointed on behalf of the debenture holders and that the works had been closed for stocktaking. There is a feeling of satisfaction at Worcester that the feared permanent closing of the factory has been avoided and that, although under new auspices, the ware for which the city has been celebrated for a century and a-half will continue to be made.

LANCASHIRE.

(From our own Correspondents.)

Manchester.

The Industrial Position.

In the course of its monthly survey of industrial conditions in the district the Manchester Chamber of Commerce reports as follows on the state of the engineering trades:—Textile machinists report that the demand for their products from various countries has fallen off. Japanese mill owners, being faced with serious competition for such business as can be done, have asked for the suspension of deliveries under recent orders, and business with India has been reduced since the boycott of British goods was started. Machinists have had several conversations on the subject of amalgamation or rationalisation, and at least one important company is preparing for the possibility of some arrangement being made to stop competition by unduly low prices. Two big engine building companies, which between them have ten subsidiaries, have arranged a rationalisation scheme from which important results are expected, although financial fusion has been avoided. Unfortunately, some works at Stockport have had to be closed. Several other companies have been either reorganising their works or adjusting their finances by extending the currency of debentures. Quite a number of

others, however, such as electrical firms and cable makers, continue to prosper.

£100,000 Coke-handling Plant for London.

An order which represents a very important addition to the work it already has in hand has been placed by the Gas Light and Coke Company, Ltd., London, with West's Gas Improvement Company, Ltd., Miles Platting, Manchester. It is for the installation of coke-handling plant valued at about £100,000 at the Beckton works of the Gas Light and Coke Company. The plant, which is claimed to be the biggest of its kind ever designed, is to be able to deal with the coke produced from 1200 tons of coal a day, and construction and erection will not be completed much under twelve months, upwards of 1000 tons of structural steel being required. Screening and loading plant, and wagon tippers and automatic weighing and recording machines will be included in the installation.

Reducing Valves by Air.

Steam reducing valves to the weight of about 4 cwt. were carried by an Imperial Airways liner which left Manchester on Tuesday of this week on its southward trip. This was the means adopted by Sir W. H. Bailey and Co., Ltd., engineers, of the Albion Works, Salford, to ensure quick delivery of an order urgently required to complete the fitting out of a floating whaling factory at Oslo. It was expected that by this course—probably unique in the history of the transport of engineering products—the valves would reach their destination in less than thirty hours.

Second-hand Plant for Australia.

About 200 tons of textile machinery, consisting of 7000 looms and other plant resulting from the dismantling of a modern mill at Heywood, is to be shipped to Australia for installation in a cotton spinning mill in that country. Altogether the market value of the machinery is in the neighbourhood of £10,000 and about 30 tons was included in the first consignment shipped on the "Zaria," which sailed from the Manchester Ship Canal last week-end.

Sewerage Loan Inquiry.

Mr. J. Gardner, an Inspector of the Ministry of Health, is to hold a public inquiry in Manchester next Tuesday into the application of the City Council to borrow £478,000 for sewerage works on the Wythenshawe estate.

Non-ferrous Metals.

Except in the lead section, which continues to display marked firmness, all the non-ferrous metals during the past week have lost ground to a varying extent. The decline in the case of tin has not been serious by any means, and in view of the active measures that are being taken to restrict output, it is not unlikely that in the near future a definite recovery from the extremely low levels that have been obtaining for some time will be recorded. In the meantime, however, stocks of the metal in this country continue formidable, and it was the announcement of the latest increase in these that introduced the fresh spell of weakness into the market. As with most of the other metals, the much-needed increase in the industrial demand has yet to make its appearance. Relative to the price the drop in copper during the past week has been more pronounced and here, also, the same factors—excessive stocks in relation to current requirements—are at work. Sales of spelter have been of limited extent, and virtually the whole of the recent recovery of prices in this section has been wiped out. In its firm stand, lead occupies an isolated position. A fair amount of buying has been witnessed and a closer balance between supply and demand than in any other section of the market for non-ferrous metals continues to be maintained.

Iron and Steel.

Not much actual improvement in the demand for Midland foundry iron that can be directly traced to the last reduction in prices can be reported on this market. It is true that a little extra business has come out, but the bulk of it is composed of small individual orders which do not amount to much in the aggregate. Until September is well advanced not much expansion can be looked for, the holidays, quite apart from the dull conditions at the foundries, having a surprisingly restrictive effect on total deliveries. In the meantime, current quotations are at 72s. per ton for both Staffordshire and Derbyshire pig iron, about 94s. for Scottish and 87s. for West Coast hematite, all delivered equal to Manchester. Only a quiet demand is reported in respect of bar iron, which, however, keeps up at £10 5s. per ton for Lancashire Crown quality and £8 15s. for No. 2. New buying in the steel section, so far as decent-sized parcels are concerned, is practically at a standstill, and this is general in almost every section of the consuming industries. Moreover, delivery specifications against old commitments are much below what they should be even for the time of the year, constructional engineers particularly being short of work, and locomotive builders taking a smaller quantity in the aggregate than they were doing a month or two ago. Boiler plates are quoted at about £9 15s. per ton, tank plates at £8 17s. 6d., sections at £8 7s. 6d., joists at £8 10s., large bars at £9 7s. 6d., and small re-rolled bars at from £7 17s. 6d. to £8.

BARROW-IN-FURNESS.

Hematite.

There is still no sign of any improvement in the hematite pig iron trade, and stocks are beginning to accumulate at the works. The fact that steel departments have been idle of late is contributing to no small extent to the increase of stocks. It is quite obvious that the present rate of consumption cannot continue and that there will have to be a curtailment of production. Customers are taking but small deliveries to meet current requirements. Foreign business is quiet, but there may be some dispatches to America. As evidence of the poor market one has only to note present prices and compare them with the East Coast figures to realise how stagnant the market is. There is not the same life in the oil trade, and with a doubtful outlook for the future the mines are not bringing up more than they are compelled to do. Foreign ore is in easy demand. The steel trade is very quiet indeed, and orders are few. Barrow rail mills are idle and there is no news of their re-starting as yet. At Workington the mills may restart in a week or two, but orders held are not many.

SHEFFIELD.

(From our own Correspondent.)

Dull Trade Conditions.

THE depression of the steel industry in the Sheffield district seems to be increasing. Conditions are very bad, and last week is regarded as probably the worst ever experienced in the steel trade. The heavy crude steel departments are suffering most, but demands for finished and special steels have fallen away considerably recently. Many of the men who were suspended from work at the beginning of the August holiday are still on the dole and others are only working for three days of the week. Only a few firms can report even moderate business, and this relates principally to special lines. The position of wagon and railway steel is particularly unsatisfactory, and there are indications of declining requirements by the British companies, which are pursuing drastic economies in all directions. The North Lincolnshire steel trade has also been suffering severely from the general shortage of work in recent months, and the output of the works in that area has decreased considerably since the beginning of the year. The facts that one of the largest firms had to close down for a fortnight's August holiday, and that one of the two blast-furnaces at the Trent Works of John Brown and Co. has been damped down, are indicative of the present position. There has been a general curtailment of production and the outlook is far from bright.

Raw Materials Cheap.

It was hoped that the reduction of the prices of foundry and forge pig iron would help to improve trade, but it has not had this desired effect. The trouble is that consumers still find it necessary to limit their purchases simply to cover immediate requirements, and as a result there are large stocks of pig iron on hand at producers' works, and production has had to be curtailed. The market for ferro-alloys is also extremely quiet and prices are described as weak.

Criticism which was Ill-founded.

Whilst the steel industry is experiencing such a lean time, it is inevitable that Sheffield citizens should watch very closely the actions of the local Corporation in placing orders for any steel required for public work. But criticism of the City Council's action in accepting the tender of a firm outside Sheffield for structural steel to be used in the erection of a public library has proved to be ill-founded. It appears that the structural steel required is not made in the city, and had the contract been given to a local firm the material would have had to be imported from the North-East Coast or some other district which specialises on girders, joists and other kinds of constructional steel. The outside firm has undertaken, however, to employ Sheffield labour and to use British steel.

Propaganda Work.

It is not very long ago that complaints were heard frequently that Sheffield steel manufacturers did not appreciate the value of advertising and did not take sufficient steps to impress upon this country and the world the value of their products. Similar charges were made against the industry as a whole. But in these days of depression it cannot be said that local firms and industrial leaders are missing any opportunity to undertake propaganda work. There is, of course, the example of the Trade Mission which the Master Cutler, Mr. A. K. Wilson, is now leading in South America, and the Chamber of Commerce in Sheffield is issuing propaganda through suitable channels. But the most pleasing effort comes from the Iron and Steel Trades Confederation, which is working with the employers to foster the "use more steel" campaign. Negotiations are now proceeding between representatives of the Confederation and the British Steelwork Association with a view to devising a scheme by which greater use may be made of British steel. Intensive propaganda has been instituted to enable the industry to obtain its fair share of the work now being put in hand to relieve unemployment.

Shortage of Engineers.

In view of the present sorry plight of the steel industry, it is, perhaps, not surprising that young men are doubtful about seeking a career in it, but it is not generally realised that there is a real shortage of trained engineers, metallurgists, &c. This state of affairs is revealed by official statements from the University of Sheffield. For some time past the Appointments Board, organised to keep local graduates in touch with possible employers, has been unable to fill all the appointments for which it has been asked by employers to make nominations. The engineering department also has been unable to find men suitable for appointments referred to it, and there is a demand which cannot be fully satisfied for young men to enter the engineering and metallurgical departments of industry. For the sake of industry, it is stated officially, many more students than are at present entering the University are required, and young men of ability and energy can with confidence take up engineering with the assurance that an appointment can be procured.

Grindstones Regulations' Effect.

The annual report—just issued—of the Chief Inspector of Factories and Workshops has some interesting references to the effect on the cutlery and edge tool industries of Sheffield of the introduction of the regulations applicable to grinding on wet grindstones. It is stated that in the majority of works the substitution of abrasive wheels for grindstones has obviated the necessity for making extensive alterations which would have been required by the regulations. In Sheffield, where there were at least 1540 grindstones working in 1926, there were in the latter part of 1929 only 654. The introduction of a new form of hood for grindstones has also helped to remove difficulties. There are some 54 such hoods in position in Sheffield, many, curiously enough, on abrasive wheels.

Cutlery and Plate.

Although the condition of the cutlery and plate trades as a whole is far from satisfactory, there are one or two bright spots to be found. For instance, some nice orders continue to be booked from Canada and South Africa, and it is stated that there is a disposition on the part of the public to take advantage of the extraordinary cheapness of silver at the present time to buy articles of that metal. But the depression of the home market is severe, and it is suggested that the tremendous output of stainless knives during the past five years is partly responsible for it, and that it is probable that the saturation point has been reached in this line. Business in safety razor blades has fallen away considerably, several firms being on short time, and it is contended that the production of these blades has been increased beyond the consumption limit.

Coke Oven Gas Scheme.

Although nothing definite has been planned yet, several serious suggestions have been made recently with regard to the use of great quantities of coke oven gas which are at present burning to waste, night and day, in various parts of South Yorkshire. There are nineteen large coke oven plants in this area, it is stated, and they can produce approximately 80,000,000 cubic feet of gas per day, suitable for domestic lighting and heating as well as for the steel and other industries. Already coke oven gas is used in large quantities by private gas companies, municipal undertakings and industrial concerns, but the suggestion is for a more general use. A network of gas mains 73 miles long is proposed.

Obituary.

The death has occurred of Mr. Robert Leader, of Sheffield, who was chairman of the Sheffield and South Yorkshire Navigation Company, and of Joseph Rodgers and Sons, the well-known Sheffield cutlery manufacturers. He was also a director of Davy Bros., steel manufacturers, and of the Sheffield Gas Company. Mr. Bernard J. Davy, of Sheffield, whose death has also occurred, was a director of the Dewhurst Engineering Company, mechanical and electrical engineers, Sheffield. The death of Mr. Cuthbert Cooper has removed the chairman and managing director of the only firm in Sheffield which makes all kinds of nails for the boot and shoe trade—Cuthbert Cooper and Sons, Ltd., of Darnall, Sheffield.

NORTH OF ENGLAND.

(From our own Correspondent.)

Nile Bridge Uncertainty.

THERE is still some doubt whether the new bridge over the Nile at Cairo to replace the existing one at Kasr-el-Nil will be built. Dorman, Long and Co., Ltd., Middlesbrough, were successful with a tender of £308,250, and secured the contract against thirteen competitors, including the principal bridge building firms of France and Germany. Events have occurred, however, which may alter the whole situation respecting the Tees-side firm's tender. There has, of course, been a drastic political change in the country, and a new Government formed which may desire important modifications in the original scheme. It is understood that the new Government want, among other things, to put a swing span in the bridge. That will, of course, alter the whole tender. Hopes are still entertained, however, that a satisfactory arrangement will be made between the firm and the Egyptian Ministry. Over 3000 tons of steel will be used in the construction of the bridge.

Cleveland Iron Prices Reduced.

No surprise will be occasioned by the decision of the Cleveland ironmasters on Wednesday to reduce their minimum prices by 4s. per ton. For some months past they have experienced a marked contraction in the demand on both home and export account, but have declined to make any concessions, despite the fact that ironmaking materials have cheapened considerably. It is hoped that the substantial reduction will check the use on Teesside of products of other home districts and foreign iron. Cleveland pig iron is now obtainable at lower figures than at any time since the war, and the previous lowest quotations prevailed in January, 1928, when market rates were based on 64s. for the standard No. 3 quality. The new prices are:—No. 1 foundry, 66s.; No. 3 G.M.B., 63s. 6d.; No. 4 foundry, 62s. 6d.; and No. 4 forge, 62s.

Blast-furnaces to be Damped Down.

With the object of avoiding the further accumulation of unsold stocks of pig iron during the period that the steel works are idle for the annual holidays, Dorman, Long and Co., Ltd., have decided to damp down a number of their blast-furnaces. This decision, which is without precedent in the history of the trade, applies to the firm's blast-furnaces except those in the Bolckow-Vaughan group—seven in all. As a further consequence of the slackness of trade the Cleveland steel works at South Bank will be closed for a fortnight instead of the usual week's holiday, which will be observed at the other steel plants.

Hematite Pig Iron.

The statistical state of the East Coast hematite pig iron trade is unsatisfactory, but producers are less

keen to book orders on terms that have been accepted of late, now that output has been brought almost into line with current needs. Much of the heavy stock is sold, and arrears of delivery against running contracts may be accepted more readily before long. Merchants have still command of rather considerable quantities and do not hesitate to unload their holdings at lower figures than makers are inclined to hold out for. Recognised market rates are based on ordinary qualities at 71s., with No. 1 quality at a premium of 6d. per ton.

Ironmaking Materials.

Foreign ore is still unsaleable. Consumers have substantial quantities on hand, and are well bought ahead. The nominal price of best Rubio remains at 20s. c.i.f. Tees. Sellers of blast-furnace coke are still prepared to take 16s. 6d. for prompt delivery of good average qualities to local users, but will not enter into contracts on forward account except on considerably higher terms.

Manufactured Iron and Steel.

Constructional steel manufacturers and producers of railway material are turning out a fair amount of work, and sheet makers have moderate orders on hand, but in all departments of manufactured iron and steel more work is urgently needed. Quotations are upheld. An order for 1000 tons of steel work for a railway bridge at Mirfield, has been received by the Furness Shipbuilding Company, Ltd., Haverton Hill. The work, which has been placed by the London, Midland and Scottish Railway Company, will be carried out by the constructional department of the Furness Company at Haverton Hill.

The Coal Trade.

The steady cutting down of production in every description of coal is now having its effect on the actual market values. The recent minimum prices are now definitely the lowest, and according to actual grades the holders are enabled to secure some slight fractional increase in value. A good volume of tonnage has been stemmed to load during August, and although the bulk of the business is against existing contracts, the general effect has been to steady the market. The output of Northumberland steams is not now in excess of inquiry. The business passing, however, is mainly by contractors. From other centres there is no definite sign of activity. Best Blyth steams are quoted at 13s. 6d., with second qualities at 12s. Best bunker coals attract a rather better inquiry, and a fair amount of business is being done at the current price of 14s. Coking coals are fairly easy, although the better qualities find a slightly improved demand. Gas coal is steady, and there is an improving tendency for best qualities. Nothing less than 15s. is accepted for best sorts, and seconds are quoted at 12s. 9d. to 13s. 3d. Gas coke is the scarcest fuel on the market. For this month there is very little to be obtained at 21s. 6d. Inquiries continue to press on the market, and should they further increase the price will appreciate. Other classes are not attracting nearly the same volume of business, and late prices are maintained under an easy tone.

SCOTLAND.

(From our own Correspondent.)

Lethargic Markets.

In most departments of industry there is a continued scarcity of new business. The requirements of local consumers are on very restricted lines and inquiries do not indicate an early expansion. Exports, too, remain dull generally. Foreign producers still operate considerably to the detriment of the home manufacturer, while in some instances, too, home competition from across the border hampers the operations of the local producer. Though on occasion a more hopeful opinion is expressed, there seems no tangible reason to anticipate an early expansion in business in any particular trade, and the outlook for the autumn months holds little encouragement.

Steel Inactive.

On the whole, steel makers have a very moderate volume of business on hand, and unless the present rate of buying is speeded up the production must be curtailed. Demands for heavy steel are most disappointing and the lighter grades are not too well supported either. Specifications for ship and boiler plates are most irregular and those for sections are not any better. Black steel sheets have a moderate turnover, the lighter gauges being fairly busy. On the other hand, galvanised descriptions are poorly placed at present. The position with regard to tubes of small diameter is not promising, and in all probability the works engaged will continue on short time for a longer period.

Iron.

For a long time back the market for bar iron has been most discouraging, and there seems little chance of a change in the meantime. The re-rolled steel bar section offers no relief at present, business being extremely difficult, with the home and export quotation at £7 12s. 6d. per ton, while foreign material can be secured quickly at considerably lower rates.

Pig Iron.

There has been no proposal to relight any of the pig iron furnaces damped down at the "Fair" holiday time, and the total number in blast in Scotland does not exceed twelve at present. Quantities of pig iron still arrive in this district from India, England and the Continent, and with demand on a restricted basis the curtailed local output is ample to meet all calls. Minimum prices are unaltered and as they are not considered over-remunerative there seems little likelihood of any further reduction until the production costs become lower.

Scrap.

Prices of scrap are unchanged at 65s. cast iron machinery, 52s. 6d. heavy steel, and about 52s. per ton heavy basic.

Coal.

Foreign demands for Scottish fuel are not extensive, and even with greatly curtailed outputs exporters can easily secure all they require. The only exception to the rule is provided by Lanarkshire splints, which are more favourably placed as regards prompt orders. Most sizes of nuts are firm. Aggregate shipments amounted to 234,348 tons, against 182,281 tons in the preceding week and 274,208 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

CONDITIONS in the steam coal trade are settling down after the holidays, and there can be no doubt that the position of most colliery undertakings is now better than it was prior to the vacation. By this it is not meant that there has been such an improvement as to affect prices favourably. Temporary stoppages are still taking place at individual pits, but they are not of so long duration in many instances. Inquiries show that most of the leading undertakings have a very fair stem on for the remainder of this month and there are prospects of that condition continuing into next month. Immediately following the holidays, the outlook was by no means so promising for the reason that tonnage arrivals were so poor, but whereas about the middle of last week there were 30 or more idle tipping appliances at the various docks, the situation at the end of the week was, that that figure was reduced to 19, while there were six steamers waiting to berth. It is not surprising to find that shipments last week were reduced. According to the official figures of the Great Western Railway Company for the six leading ports in this district, the total came to only 315,100 tons, which was about 30,000 tons less than for the corresponding period of last week, while, compared with the preceding week, the reduction was no less than 188,100 tons. Hopes are entertained that the returns for the current week will make a much better showing. They certainly should do so, as the tonnage position on Monday disclosed that there were only 14 idle tipping appliances at the various docks, while nine vessels were waiting. On Tuesday there were 21 tips idle and three steamers waiting. There have also been a few more orders on the market, but nothing like what is required to induce real activity. There is also a certain amount of business being negotiated over the remainder of the year, and French railways are reported to be in the market for about 40,000 tons of large coals, for delivery over next year, though those railways are frequently asking prices. The Palestine railways have asked for tenders for 8000 tons of best large steams, and the Royal Ordnance Depôt, Woolwich, requires prices for smalls, gas coals and various other grades, reaching a total of about 50,000 to 60,000 tons for delivery over six or twelve months.

Unemployment.

It cannot, of course, be denied that there is a good deal of unemployment in the South Wales coalfield and the industries allied to it. Up to now it is understood that the Great Western Railway Company has dismissed 24 tippers employed at the docks at Penarth and Barry, and in the case of the ship-repairing industry considerable numbers of men have had a very thin time for months past, owing to the reduction of tonnage trading to this district. Since the holidays, reports of several pits re-starting have appeared, which is a healthy sign. There was considerable rejoicing at the end of last week at Bryn, which is between Port Talbot and Maesteg, when the new slant driven by the Bryn Navigation Colliery, owned by Baldwin's, Ltd., was officially opened and the first trams of loaded coal were drawn out. This slant has been driven 1232 yards into the middle and lower seams of steam coal. There are now about 900 men engaged at these collieries, but this slant will provide employment for 700 to 800 men when fully developed.

Ship-repairing Competition.

An instance of the severity of competition in the ship-repairing industry has occurred during the past week or so. A Cardiff-owned steamer, "Pentreath," which ran aground near Vada Lighthouse recently, and sustained damage estimated to occupy about three weeks' employment, was put out to tender, but, unfortunately, for the workers in this district, the order was lost. The contract was secured by T. W. Greenwell and Co., Ltd., of Sunderland, whose price was approximately £1000 below the lowest tender submitted by a South Wales undertaking, and the steamer has, therefore, to leave Bristol for the North. On this showing it would look as if Bristol Channel firms were not at all in the running and that their competitive position was hopeless, and yet the bulk of the tenders submitted by local undertakings were below those of outside firms, some of them being £1000 to £1500 less than competitors in other districts, which shows that the Sunderland firm which was successful must have made a drastic cut for the business.

Current Business.

Generally speaking, there is not much change in the tone of the steam coal market, but it certainly is not so weak, as numerous collieries are better booked for the remainder of this month. The large coal position is improved, particularly for the collieries producing best qualities. Smalls are still freely obtainable and display no alteration, but the feature is the continued strength of sized qualities, for which there is always a market. Dry sized coals are quoted steadily at 22s. There can be no doubt that coalowners recognise the fact that this is the most promising section of the market and are doing all they can to increase their output of sized descriptions. Many undertakings would, without question, put down plant immediately if they had the financial resources. Coke and patent fuel show no material change, but pitwood is weaker since last week and is now about 27s. 9d. to 28s. 3d.

LAUNCHES AND TRIAL TRIPS.

TAFELBERG, whaling factory steamer; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd., to the order of the Kerguelen Sealing and Whaling Company, Ltd.; dimensions, 520ft. by 72ft.; to carry 16,300 tons deadweight. Engines, triple-expansion, pressure 200 lb. per square inch; conatructed by Sir W. G. Armstrong, Whitworth and Co. (Engineers), Ltd.; trial trip, July 14th.

SEA RAMBLER, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Dover Navigation Company, Ltd.; dimensions, 305ft. by 43ft. by 20ft. 10in.; to carry 3500 tons deadweight. Engines, triple-expansion; constructed by North-Eastern Marine Engineering Company, Ltd.; launch, July 15th.

TAWALI, motor ship; built by the Netherland Shipbuilding Company, Ltd., to the order of N.V. Stoomvaart Maatschappi "Nederland;" dimensions, 490ft. 1in. by 62ft. 2¾in. by 36ft. 5in.; to carry 10,000 tons. Engines, 7000 Werkspoor-Sulzer; constructed by Nederlandsche Dok-Maatschappi N.V.; launch, July 19th.

SILVERWALNUT, motor ship; built by Harland and Wolff, Ltd., to the order of the Silver Line, Ltd.; dimensions, 455ft. by 61ft. 9in. by 40ft.; gross tonnage, 6770. Engines, two sets of single-acting Diesel, Harland-B. and W. type; constructed by the builders; trial trip, July 23rd.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE INTERNATIONAL ELECTROLYTIC PLANT COMPANY, the head office and laboratory of which are at present at New Crane-street, Chester, asks us to announce that it has taken over the works formerly occupied by the Sandycroft Foundry Company, Ltd., at Sandycroft, near Chester, and that in the near future it will transfer both its factory and its offices to those new premises. It is anticipated that the transfer will be completed in about two months' time.

OERTZ INTERNATIONAL STREAMLINE RUDDER COMPANY, Ltd., of Lloyds Avenue House, 6, Lloyds-avenue, London, E.C. 3, asks us to announce that it has taken over its British Empire agency which was formerly managed by the Marine Navigation Company, Ltd., and that all business relating to that territory will in future be conducted from the address given. The entire technical staff has also been taken over, and will be under the management of Mr. R. Mayo.

METROPOLITAN-VICKERS ELECTRICAL CO., Ltd., asks us to announce that it has to-day opened a new lamp depôt and trade counter for the sale of its "Cosmos" lamps at 53, Aire-street, Leeds. Telephone No. 20444. Telegraphic Address, "Multiphase, Leeds." The company's general engineering business will, however, continue to be dealt with from its office at Permanent House, The Headrow, Leeds. Telephone Nos. 20444 and 20445. Telegraphic Address, "Multiphase, Leeds."

ALLOY WELDING PROCESSES, Ltd., of Ferry-lane, Walthamstow, E. 17, asks us to announce that practically the whole of its issued shares have been purchased by Murex, Ltd., which possesses works at Rainham, Essex, and the business of which is the treatment of complex ores and the manufacture of various alloys and of carbon-free metals. Murex, Ltd., also owns all the share capital of the Premier Electric Welding Company, Ltd., also that of Thermit, Ltd. The works of the Premier Electric Welding Company, Ltd., will shortly be removed to the works of Alloy Welding Processes, Ltd.

CONTRACTS.

THE ENGLISH ELECTRIC COMPANY, Ltd., has received from Brown Bayley's Steel Works, Ltd., of Sheffield, an order for the whole of the electric plant required to drive a 27in. reversing mill.

THE ENGLISH ELECTRIC COMPANY, Ltd., has received from the County Borough of Walsall an order for two A.E.C.-English Electric double-deck low-loading trolley omnibuses. Each vehicle is to have a seating capacity for sixty passengers. The chassis will be built by the Associated Equipment Company, Ltd.

THE LONDON CHAMBER OF COMMERCE SCHOLARSHIP AWARDS.—Two "Charles R. E. Bell Fund" Senior Travelling Scholarships of £150 each have been awarded for 1930 by the Commercial Education Committee of the London Chamber of Commerce. One was gained by Mr. James B. Wright, of Sheffield, who qualified in English and came first in a modern foreign language, while the second was gained by Mr. John P. Furnivall, of Catford, who qualified in English and came second in a modern foreign language. Both candidates will reside abroad for a period of not less than six months. Two further Travelling Scholarships of £150 each will be offered by the Chamber for competition in 1931. The successful candidate for the "Charles R. E. Bell Fund" Junior Scholarship of £60, offered by the London Chamber of Commerce on the results of the summer (July) examinations, was Rowland Kibble, presented from the L.C.C. Dalston Central School, Lansdowne-road, London, E. 8. The London Chamber of Commerce offers annually two "Charles R. E. Bell Fund" Senior Travelling Scholarships of £150 each, and two "Charles R. E. Bell Fund" Junior Scholarships of £60 each.

ROBERT BLAIR FELLOWSHIPS.—Robert Blair Fellowships have been awarded to Mr. Cyril H. Bowden, of Felixstowe, and to Mr. Philip Carpenter, of London. These fellowships, which carry a grant of £450, are the most valuable scholarship awards in the gift of the London County Council. Mr. Bowden is twenty-two years of age. He was educated at Felixstowe Secondary School, Birmingham University and Imperial College of Science and Technology. He is a B.Sc. (Lond.) (Class I. Hons.) and has also been awarded an Associateship Diploma First Class of the Royal College of Science. He has been engaged upon research work in the physical chemistry department of the Imperial College of Science. He proposes to study chemical engineering at the Massachusetts Institute of Technology. Mr. Carpenter is also twenty-two years of age and is a B.Sc. (Lond.) (Class I. Hons.). He has been awarded an Associateship Diploma of the Royal School of Mines. He proposes to visit mines in the United States to study the principles and practice of the flotation process for separating minerals from their ores with a view to the value of its application on the large copper field now being opened up in Northern Rhodesia.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast,	
(1) Native	17/9 to 20/6
(1) Spanish	20/6 to 21/–
N.E. Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	20/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 19 6	—
No. 1 Foundry	3 19 0	—
No. 3 Foundry	3 16 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 11 6	3 11 6
Cleveland—		
No. 1	3 6 0	3 6 0
Siliceous Iron	3 6 0	3 6 0
No. 3 G.M.B.	3 3 6	3 3 6
No. 4 Foundry	3 2 6	3 2 6
No. 4 Forge	3 2 0	3 2 0
Mottled	3 1 6	3 1 6
White	3 1 6	3 1 6
Midlands—		
(c) Staffs —	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 8 6	—
„ „ Foundry	3 13 6	—
(c) Northampton—		
Foundry No. 3	3 10 0	—
Forge	3 5 0	—
(c) Derbyshire—		
No. 3 Foundry	3 13 6	—
Forge	3 8 6	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 3 6 (a); 4 6 6 (b); 4 10 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
Lancs.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 2 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	9 0 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	12 15 0	12 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 10 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
Manchester—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 17 6 to 8 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 15 0	—
Sheffield—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	6 10 0	—
Hoops	9 15 0	—
Soft Wire Rods	8 0 0	—
Midlands—		
Small Rolled Bars	7 17 6 to 8 10 0	—
Billets and Sheet Bars	5 17 6 to 6 5 0	—
Galv. Sheets, f.o.b. L'pool	11 17 6	—
(2) Staffordshire Hoops	10 0 0	—
Angles	8 7 6	—
Joists	8 10 0	—
Tees	9 7 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/– to 18/1½
Block Tin (cash)	135 15 0
„ (three months)	137 10 0
Copper (cash)	47 16 3
„ (three months)	47 18 9
Spanish Lead (cash)	18 3 9
„ „ (three months)	18 3 9
Spelter (cash)	16 0 0
„ (three months)	16 11 3
Manchester—	
Copper, Best Selected Ingots	52 10 0
„ Electrolytic	52 10 0
„ Strong Sheets	79 0 0
„ Tubes (Basis Price), lb.	0 0 11½
Brass Tubes (Basis Price), lb.	0 0 10½
„ Condenser, lb.	0 1 0½
Lead, English	19 17 0
„ Foreign	18 2 6
Spelter	16 10 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/6 per lb.	
Ferro Tungsten	2/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 12 6	7/–
„ „ 6 p.c. to 8 p.c.	£22 10 0	7/–
„ „ 8 p.c. to 10 p.c.	£22 0 0	7/–
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£33 10 0	10/–
„ „ „ 1 p.c. carbon	£38 0 0	13/6
„ „ „ 0·70 p.c. carbon	£39 0 0	15/–
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 15 0 for home	
„ „ „	£11 0 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/– per unit	
„ „ 75 p.c.	£19 0 0 scale 7/– per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	12/6
„ „ Eli	13/–
„ „ Splint	14/– to 15/6
„ „ Trebles	12/6 to 13/–
„ „ Doubles	12/6
„ „ Singles	11/3 to 11/6
Ayrshire—	
(f.o.b. Ports)—Steam	13/3
„ „ Jewel	16/–
„ „ Trebles	13/–
Fifeshire—	
f.o.b. Methil or Burntisland—Steam	10/9 to 12/–
Screened Navigation	16/6 to 17/6
Trebles	13/6
Doubles	12/6
Singles	11/6
Lothians—	
(f.o.b. Leith)—Best Steam	11/6
Secondary Steam	11/–
Trebles	12/6 to 13/–
Doubles	12/6
Singles	11/6 to 12/–

ENGLAND.

(8) N.W. Coast—	
Steams	20/6 to 21/–
Household	32/– to 51/–
Coke	20/– to 21/–
Northumberland—	
Best Steams	13/6
Second Steams	12/–
Steam Smalls	10/– to 10/6
Unscreened	12/6
Household	26/– to 37/–
Durham—	
Best Gas	14/9 to 15/–
Second	12/9 to 13/–
Household	25/– to 37/–
Foundry Coke	24/– to 26/–

Sheffield—	Inland.	
Best Hand-picked Branch	24/– to 25/6	—
Derbyshire Best Bright House	19/– to 21/–	—
Best House Coal	18/– to 19/6	—
Screened House Coal	16/– to 17/–	—
„ „ Nuts	14/– to 16/–	—
Yorkshire Hards	14/– to 15/6	—
Derbyshire Hards	14/– to 15/6	—
Rough Slacks	8/6 to 9/–	—
Nutty Slacks	7/– to 8/–	—
Smalls	3/– to 5/–	—
Blast-furnace Coke (Inland)	15/6 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b.	17/– to 18/6	

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	20/–
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	18/3 to 18/6
Western Valley Large	18/– to 18/3
Best Eastern Valley Large	17/9 to 18/–
Ordinary Eastern Valley Large	17/6 to 17/–
Best Steam Smalls	13/6 to 14/–
Ordinary Smalls	12/6 to 13/–
Washed Nuts	19/– to 22/–
No. 3 Rhondda Large	20/– to 20/6
„ „ Smalls	15/6 to 16/–
No. 2 „ Large	17/– to 17/3
„ „ Through	16/– to 16/6
„ „ Smalls	14/– to 14/3
Foundry Coke (Export)	27/6 to 37/–
Furnace Coke (Export)	21/– to 21/6
Patent Fuel	22/–
Pitwood (ex ship)	27/9 to 28/3
Swansea—	
Anthracite Coals:	
Best Big Vein Large	35/– to 37/6
Seconds	27/6 to 31/6
Red Vein	23/6 to 27/–
Machine-made Cobbles	41/6 to 45/–
Nuts	40/– to 46/–
Beans	24/6 to 27/6
Peas	20/– to 21/–
Breaker Duff	10/– to 10/6
Rubbly Culm	11/6 to 12/6
Steam Coals:	
Large	19/6 to 21/6
Seconds	18/– to 19/6
Smalls	12/– to 13/–
Cargo Through	15/6 to 16/–

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 12/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/– if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country stations.

French Engineering Notes.

(From our Correspondent in Paris.)

Labour Agitation.

THE strikes amongst operatives in the engineering shops at Lille and the weavers in the Roubaix district have extended. The trouble arose over an ultimatum by the men's unions insisting upon an immediate advance in wages to compensate for increased living costs, which the men's representatives declare are due to the application of the new social insurance scheme. This attitude was the more surprising because the employers had so far been on friendly terms with the unions, and these latter had accepted an arrangement whereby the existing rates of wages would be maintained until an official inquiry had been made into the extent to which living costs had increased. Employers in the engineering trades affirm that they can only abide by this agreement. They refuse to have any more discussion with the unions. The men must return to work pending the inquiry which will be carried out as rapidly as possible. There does not appear any likelihood, at the moment, of an early settlement of the dispute. The application of the compulsory insurance scheme is also made the pretext for strikes elsewhere. Some have failed and the men have returned to work at the old wages, but there nevertheless continues to be an agitation on account of the increased cost of living, which, it is feared, may go still higher in view of the bad grain harvest.

Refuse Disposal.

The Superior Council of Health has decided to organise some trials of apparatus for the disposal of household refuse in small and medium-size towns. There will be, first, an eliminating competition, when a jury will examine proposals submitted for a plant capable of dealing with the refuse of a town of 10,000 inhabitants. The plant must consist of units that can be added to for extensions, and no proposal will be considered that does not meet this condition. Competitors are required to send sketches of their plants for treating refuse in any way they please. They must also supply information about the space occupied by a unit, the material used in its construction, its estimated cost and the time occupied in carrying out the process of destroying or utilising the refuse. Three prizes amounting altogether to 65,000f. will be distributed as a contribution towards the expenses incurred by competitors. The latest date for receiving the documents is January 1st next. The schemes approved of by the judges will be subjected to a practical test in the neighbourhood of Paris, where the plants will deal with quantities of refuse equivalent to those usually produced by a town of 10,000 inhabitants.

Shipbuilding.

About a year ago a law was passed authorising the importation free of duty of raw material used in the construction or repair of merchant ships and the suppression of the import tax on marine engines, auxiliary machinery, boilers and other equipment for ships, although the import duty would still be paid on such machines and accessories. Another decree has just been published indicating the conditions under which such raw material and machines can be imported in order to benefit from the suppression of the duty or tax, as the case may be. The precautions taken to ensure that the material imported is used solely for the construction of sea-going merchant ships are very complicated, and although the idea is to allow of shipbuilders working under the same conditions of economy as their foreign competitors, they can only do so by carrying out many formalities. Nevertheless, the law is favourable to the importation of British ship plates and other shipbuilding material.

The Claude Power Scheme.

After the second accident to the tube which he wants to lay in Matansas Bay, Cuba, with a view to recuperating energy from the warm sea water, Monsieur Georges Claude has returned to Paris and will shortly go back to Cuba for another attempt to lay the tube which, he says, will soon be ready for immersion. He declares that the second accident was due to the failure of the men engaged in the sinking to carry out instructions. The tube, 2000 m. long and about 5ft. 4in. in diameter, was erected on floats, and instead of beginning to sink it from the shore end, the floats were punctured at the opposite extremity, when the weight of the sinking part broke the tube that remained afloat.

Iron and Steel Production.

The decline in the output of pig iron and steel has reduced the average monthly production during the first half of the year, which, in the case of pig iron, was 858,000 tons, as compared with the monthly average for the whole of 1929 of 864,000 tons. In June the 147 furnaces in blast produced 849,000 tons. Of that amount 648,000 tons were Thomas phosphoric pig and 105,000 tons foundry iron. There were 69 furnaces damped down or under construction. The average monthly steel production during the six months was 805,000 tons, while the total for June fell to 770,000 tons, the lowest since the beginning of the year. The monthly average for the whole of 1929 was 808,000 tons. Amongst the finished products in June, rails and accessories accounted for 66,000 tons, girders for 70,000 tons, special steel bars and rolled merchant iron for 198,000 tons, and steel sheets and plates for 143,000 tons.

Motor Cars.

A meeting of representatives of the motor car trade in different continental countries has been held in Paris to discuss proposals for placing the industry on a more satisfactory basis, particularly in the way of limiting the importation of cars and adjusting the production to the needs of home markets. The foreign trade in cars has fallen off so considerably that those makers who build largely for export find the outlook extremely precarious. The meeting was unanimous concerning the necessity of limiting the importation of cars into the manufacturing countries represented, but it failed to agree on other matters and negotiations have been postponed.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

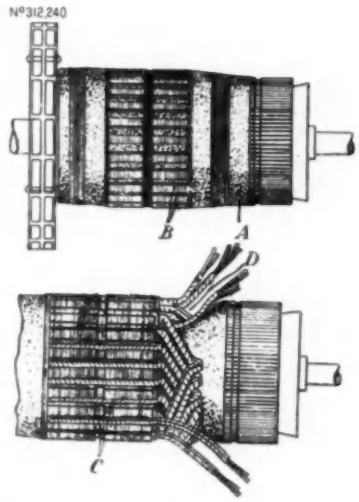
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

312,240. May 22nd, 1929.—ELECTRICAL WINDINGS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

During the operation of an armature excessive vibration of the coils and commutator leads may occur, particularly when the armature is operated at high speeds and when there is any appreciable amount of stray magnetism. Consequently, if the armature coils and leads are not rigidly held in position, the excessive vibration causes breakage of the armature leads which results in armature failure. It will also be understood that it is often necessary to operate small motors, for instance, those used in railway service, at high temperatures and efficient cooling means must be provided for the coils or else the insulating materials will fail. According to the invention these difficulties are overcome by providing an insulating binding and heat-conducting material in the form of a plastic putty made of an asphaltum varnish mixed with proper proportions of soapstone. It has been found that a mixture comprising approxi-

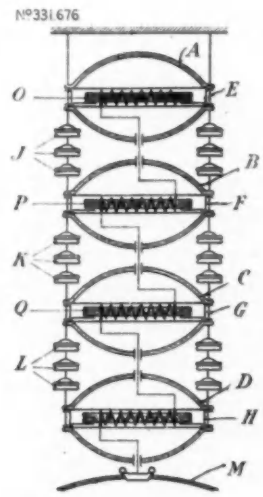


mately 60 per cent. cementing and insulating asphaltum varnish and approximately 40 per cent. powdered soapstone gives very satisfactory results. Preferably the asphaltum varnish should comprise a large percentage of asphalt dissolved in a suitable hydrocarbon solvent. The putty A is progressively applied, as the coils are laid in the recesses B. For instance, a small amount of the putty is placed in the armature recesses, an armature coil C placed upon this layer of putty, then a layer of putty is placed upon the armature coil, upon which another armature coil is placed, if desired. The spaces D are provided with layers of putty upon which the end turns and commutator leads are placed. After the armature has been so constructed and packed, the whole is subjected to a baking process by which the putty is rapidly heated to a temperature of about 125 deg. Cent., at which temperature the volatile constituents are driven off. Preferably, the putty is heated by passing an electric current through the coils, so that the volatiles will be forced outwardly from the interior portions of the putty.—*July 10th*, 1930.

TRANSFORMERS AND CONVERTERS.

331,676. June 19th, 1929.—EARTHED CHOKING COILS OR TRANSFORMERS IN CASCADE, Koch and Sterzel A.G., of 40–42, Zwickauerstrasse, Dresden, Germany.

According to this invention the casings of the individual

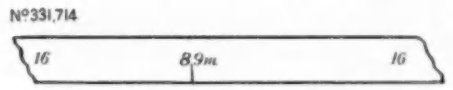


choking coils or transformers are connected together vertically one above another to constitute a means of suspension for a conductor. The casings may be made of any material, preferably of an insulating material, and are connected to one another at their ends, or at least at two points of their circumference, by insulator chains by which they are suspended. The drawing shows the application of the invention to earthed coking coils. The casings A to D are constituted by two shell or basin-like parts, which are held together by conducting holders E to H, by which they are also secured to the suspension insulator links J, K, L. In the example illustrated, the casings arranged one above another are supported by a double suspension chain, which is secured at its upper end to a ceiling or to a pole and supports at its lower end, by means of suitable fittings the high-tension line M. In each casing there are one or more openings for the wires connecting the choking coils O to Q.—*July 10th*, 1930.

TELEGRAPHS AND TELEPHONES.

331,714. July 26th, 1929.—COIL-LOADED ELECTRIC SUBMARINE CABLES, Felten & Guilleaume Carlswerk Actien-Gesellschaft, of Köln-Mülheim, Germany.

For repairing a damaged submarine cable, it is hauled aboard the repairing ship in the vicinity of the faulty place which has previously been ascertained on land. In the case of a pupinised cable, it is of great importance for the subsequent operations to know the distance from the nearest coil sleeve. The reasons for this are both of a mechanical and electrical nature. In order to be able to determine at every point on the cable the distance from the nearest coil sleeve, each loading coil section is provided during manufacture with a measuring band with a continuous series of graduations extending along it, in contradistinction to

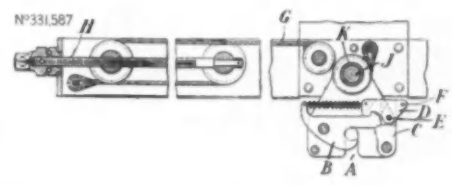


former proposals of providing the whole of the cable with one continuous measuring band. Preferably the measuring band is marked in a manner which enables the different loading coil sections to be identified. The drawing illustrates a portion of a measuring band according to the invention. The middle number indicates the number of metres calculated from the beginning of the corresponding coil section, whilst the numbers —for instance, 16—which occur at short distances, indicate the number of the coil section. The measuring band may be disposed either under or over the lead sheath under the armouring. In the former case a very cheap material may be used—for instance, a printed paper strip—as it is protected by the lead sheath from all destroying influences.—*July 10th*, 1930.

AERONAUTICS.

331,587. April 6th, 1929.—DEVICES FOR CARRYING HEAVY BODIES ON, AND RELEASING THEM FROM, AIRCRAFT, Vickers-Armstrongs, Ltd., Vickers House, Broadway, Westminster, and B. W. A. Dickson.

In this bomb carrying and dropping device the bomb is carried in the slot A by the catch B, which is supported by the bent C. The bent is prevented from accidental disengagement with the catch B by the auxiliary catch D, which is pivoted at E to an

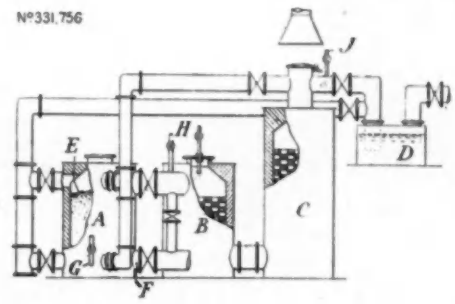


upward extension of the bent C. When a wire which is attached to the auxiliary catch D at the point F is pulled the auxiliary catch D is first opened and then the bent C is pulled away from under the catch B to release the bomb. In order to pick up the bomb in the first place the whole catch assembly is supported by the rope G and can be lowered or raised by the screw H. When in the top position the weight is carried by the pin J, which is slipped through the hollow axle of the pulley K.—*July 7th*, 1930.

GAS PRODUCERS.

331,756. September 10th, 1929.—MAKING MIXED OIL GAS AND WATER GAS, *Humphreys and Glasgow, Ltd.*, 38, *Victoria-street, Westminster.*

According to this invention, the process of making mixed oil gas and water comprises air blasting an ignited fuel bed and burning the air blast gases in their passage through and out of a carburetter and superheater to heat the same, passing oil through the chamber in the same direction as the direction of passage of the air blast gases, and then through the fuel bed to vaporise



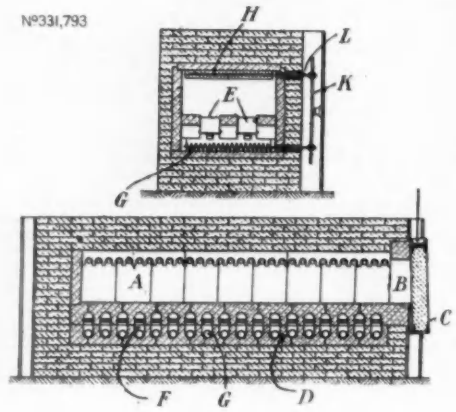
the oil and crack the vapours and reform the gas with deposition of carbon in the fuel bed, and steaming the fuel bed to make water gas and to remove the deposited carbon. In the drawing A generally indicates the generator, B the carburetter, C the superheater, and D the wash box. The generator contains the fuel bed E, and has air and steam supplies F and G respectively for up blasting and up steaming. The fuel bed may be steamed downwardly by steam admitted at H or J. The specification includes a comprehensive description of the operation of the plant.—*July 10th*, 1930.

FURNACES.

331,793. November 19th, 1929.—ELECTRIC ANNEALING FURNACE, Hirsch, Kupfer- und Messingwerke, Aktiengesellschaft, of Messingwerke, near Eberswalde, Germany.

In electric annealing furnaces, which are charged by means of

a cantilever arm charging machine, spaces must be provided in the furnace hearth in which the arms of the machine can engage on the insertion or removal of the annealed articles. In such furnaces the position of the heating resistances at the furnace hearth is attended with the drawback that the arms of the machine often abut against the refractory bricks forming the furnace hearth, with the result that the heating resistances arranged in or on these bricks are damaged or entirely destroyed. This invention is intended to obviate that drawback. The

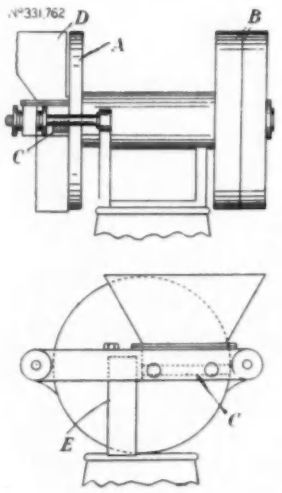


annealing chamber A of the furnace is fed through an opening B provided with a door C. The bottom of the annealing chamber is formed of refractory bricks D, between which open spaces E are left in which the arms of the machine engage on feeding and emptying the furnace. The refractory bricks are provided with recesses F extending under the lowest working position of the arms, and the heating resistances G are placed at the bottom of the recesses. Heating resistances H are also arranged on the roof of the furnace and current is led to the resistances by conductors K, L.—*July 10th*, 1930.

CRUSHING AND GRINDING.

331,762. September 17th, 1929.—Paint Grinding Mills, Disc Bar Mills, Ltd., 10, Essex-street, Strand, W.C. 2, and E. A. White, 93, Drayton-gardens, London, S.W. 10.

This paint mill comprises a disc A, driven by the belt pulleys H and a fixed grinding block C. It is stipulated that the co-acting surfaces of the disc and block may be either smooth or roughened. The paint or other material is fed from the hopper D between

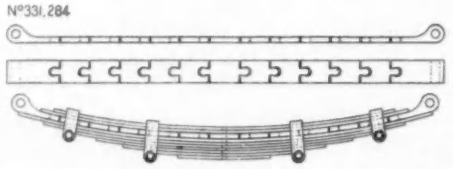


the disc and the block, and is scraped off after grinding by the knife E. It is pointed out in the specification that owing to centrifugal action the heavier particles of material, which require more rapid grinding than the finer particles, will be thrown out towards the circumference of the disc, and as that part is rotating at a greater speed than the part nearer to the centre, the coarser particles will actually receive more rapid grinding.—*July 10th*, 1930.

MISCELLANEOUS.

331,284. April 6th, 1929.—Laminated Springs, Wm. Griffith and Sons, Ltd., and A. E. Frost, Napier Steel and Spring Works, Saville-street East, Sheffield.

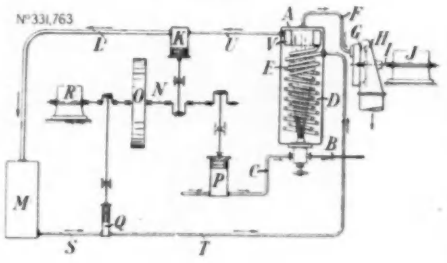
The object of this invention is to avoid the breakage of the master leaf of a laminated spring. The master leaf is built up



of a number of short sections connected together by lugs and recesses, which are of a sufficiently slack fit to allow flexure without it being possible to pull the sections apart. This master leaf is assembled between the leaves of the spring and the whole bunch is clamped together in the usual manner.—*July 3rd*, 1930.

331,763. September 19th, 1929.—Power Plants, Sulzer Frères Société Anonyme, Winterthur, Switzerland.

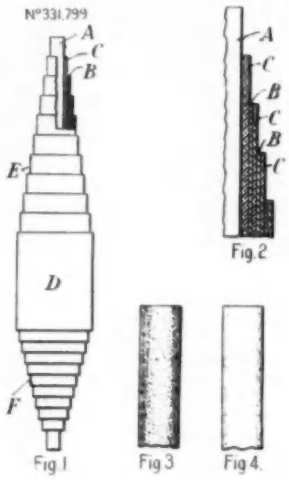
We give this specification *in toto* as it appears to be of a rather radical nature. The invention relates to power plants of the kind comprising a turbine which is operated by gases at high pressure derived from combustion, and a high-pressure steam generator deriving heat from such combustion gases before they pass to the turbine and supplying steam to one or more steam power units, hereinafter termed for the sake of convenience a steam power installation, and has for its object to enable combustion to take place at a high temperature while maintaining a high economic efficiency of the whole plant. To this end, according to the present invention, the high temperature combustion gases deliver up such of their heat to the steam generator before they are delivered to the turbine as to enable the steam power installation which operates independently of the turbine to supply at least the greater part of the power required for the compression of the air for combustion. The combustion preferably takes place at constant pressure, but may take place at constant volume and either within the steam generator or outside it. The regulation of the steam power installation and of the gas turbine may be effected in dependence upon one another, while the regulation of the steam generator may be effected in accordance either with the operation of the gas turbine or that of the steam power installation. Again, the supply of fuel and air to the combustion chamber may be controlled in accordance with the operation of the steam power installation, of the gas turbine, or of the steam generator. In any case, the control of the plant may be such that the pressure of the combustion gases entering the turbine is maintained substantially constant. The type of steam power unit or units employed in the steam power installation may vary. Thus such steam power installation may comprise a reciprocating engine constituting a high-pressure stage and a steam turbine constituting a low-pressure stage, and in such a case the reciprocating engine may drive a reciprocating air compressor and the steam turbine a turbo-compressor. Alternatively, combustion air may be compressed in a low-pressure stage operated by a turbo-compressor driven by the gas turbine prior to being further compressed by one or more compressors driven by the steam power installation. Two or more combustion chambers may also be employed. The invention may be carried into practice in various ways, but one arrangement of power plant, according to this invention, is illustrated diagrammatically by way of example in the accompanying drawing. In the arrangement shown in the drawing the steam generator A is provided with a burner to which fuel is supplied by a pipe B and compressed air by a pipe C, the fuel and air being directed by the burner into and burning in a combustion chamber D in which is arranged a system of water tubes E. Leading from the end of the combustion chamber D remote from that at which the fuel and air enters is a pipe F for conveying combustion gases to the nozzle ring G of a gas turbine H, the shaft I of which is connected to an electric generator J. The system of tubes E is connected to a steam or steam and water chamber V, from which leads a pipe U to a reciprocating steam engine K connected by means of an exhaust pipe L to a condenser M. The crank



shaft N of the steam engine K carries a fly-wheel O and is coupled to a reciprocating air compressor P, to a feed water pump Q and to an electric generator R. The feed water pump Q draws water from the condenser M through a pipe S and delivers it through a pipe T to the system of water tubes E. The operation of the installation illustrated is as follows. The combustion of the fuel and air delivered through the pipes B and C respectively at high pressure takes place in the combustion chamber D constituting part of the steam generator. Part of the heat from the hot gases thus generated is transferred to the system of water tubes E, whereby steam is generated at high pressure and collected in the chamber V of the steam generator. The steam thus formed is supplied through the pipe U to the reciprocating steam engine K. In the construction illustrated the engine K drives not only the reciprocating air compressor P for supplying the compressed air for combustion through the pipe C, but also the feed pump Q and, if desired, further auxiliary machines or pumps not shown in the drawing, any excess power generated being converted into electrical energy by the generator R. The exhaust steam from the steam engine K passes through the pipe L and is condensed in the condenser M, the condensate being returned by the feed pump Q to the system of water tubes E of the steam generator. The combustion gases which have been partially cooled owing to the transfer of heat therefrom to the water in the tubes E pass through the pipe F to the nozzle ring G of the gas turbine H, which drives the electric generator J. The air compressor may be of the multi-stage type and the lowest stage of compression may be effected by a turbo-blower driven by the gas turbine and one or more higher stages by a compressor driven by the steam power installation. In the construction illustrated the pressure in the steam generator A may be assumed to be about 100 atmospheres above atmospheric pressure, the pressure in the combustion chamber D about 50 atmospheres above atmospheric pressure, and the power required to drive the compressor, 25 to 35 per cent. of the sum total of the power generated by the steam power installation and the gas turbine. The power generated by the steam power installation may, therefore, amount in a large installation to several thousand horse-power. The pressures in the steam chamber of the steam generator and in the combustion chamber may, however, be either smaller or greater than the pressures indicated above and the relation between these pressures may vary according to circumstances. Further, instead of a reciprocating steam engine, either of the single-stage type, as diagrammatically shown, or of the multi-stage type, a steam turbine may be employed for operating the air compressor. Alternatively, a reciprocating engine may be employed for the high pressure stages of the steam power installation and a steam turbine for the low-pressure stages, the reciprocating steam engine driving, for example, a reciprocating air compressor and the turbine a turbo-blower. The electric generators J and R, driven respectively by the gas turbine and the steam power installation, may also either work independently or be electrically coupled together.—*July 10th*, 1930.

331,799. December 4th, 1929.—Electrical Insulating Bushings, *Associated Electrical Industries, Ltd., of Bush House, Aldwych, Westminster.*

The object of the invention is to provide a condenser bushing in which the power loss, in the form of heat, as compared to similar bushings, shall be greatly reduced. The device comprises a central through conductor A and a number of alternate conducting and dielectric cylinders or layers B and C respectively. The layers B and C are of successively outwardly greater diameters and lesser lengths to provide nearly equal capacities, or any desired grading of capacities between the conducting layers B. This arrangement results in a structure, as shown in Fig. 1, having an intermediate cylindrical body portion D, and tapered or stepped end portions E and F respectively. The intermediate portion D is for mounting the bushing in an opening in a tank cover and the end portions E and F may be of any desired relative lengths in accordance with the service for which they are adapted and of the medium in which they are to operate. The conducting layers may be of any suitable material, such as lead or tinfoil, but are preferably of embossed aluminium foil having one or both surfaces treated or coated with a binder, such as shellac. The dielectric layers C, although illustrated in Figs. 1 and 2 for clearness as comprising a single thickness of solid dielectric material, are each preferably wound of several layers of paper, each layer being provided on one or both sides thereof with a binder similar to that on the conducting layers B. The layers B and C are preferably prepared in advance, with the shellaced surfaces applied thereto and dried. These layers are then wound under heat and pressure, causing the shellac momentarily to soften and permanently to harden,



whereby the conducting and dielectric layers B and C are securely bonded to each other. Fig. 3 illustrates an edge view of the porous paper heretofore employed, magnified many times, since it is actually relatively thin, being of a thickness of approximately nine to twelve-hundredths of a millimetre—0·09 mm. to 0·125 mm. This paper, under the above described process of shellacking and winding, under heat and pressure, becomes thoroughly penetrated or impregnated with the shellac, as indicated by the stippling in Fig. 3. Fig. 4 is a similar view of the more dense paper, which only permits the shellac to penetrate it to less than one-half its depth as indicated by the stippling. However, the penetration or adherence is sufficient to provide a bond between the several layers thereof and between the paper and the foil that is as effective as in the prior practice.—*July 10th*, 1930.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

WEDNESDAY TO WEDNESDAY, SEPTEMBER 3RD TO 10TH.

British Association for the Advancement of Science.—Bristol meeting. The presidential address, by Professor F. O. Bower, will deal with "Size and Form in Plants." Evening discourses will be given by Professor E. V. Appleton, F.R.S., on "Wireless Echoes," and by Dr. R. E. Slade on "The Nitrogen Industry and our Food Supply." Evening receptions and excursions to points of scientific interest, works, &c., in the locality will be arranged.

THURSDAY TO SUNDAY, SEPTEMBER 4TH TO 7TH.

International Congress of Consulting Engineers.—Fifth Congress at Vienna.

TUESDAY TO FRIDAY, SEPTEMBER 9TH TO 12TH.

Institute of Metals.—Annual autumn meeting, Southampton. Continued from September 13th to September 16th by a visit to France. The meetings at Southampton will be held in the Chantry Hall, and on September 9th Professor D. Hanson will read a paper on "The Use of Non-ferrous Metals in the Aeronautical Industry." 8 p.m. **For programme see page 88.**

SATURDAY, SEPTEMBER 13TH, TO SATURDAY, SEPTEMBER 20TH.

Liverpool.—Centenary celebrations of the Liverpool and Manchester Railway.

SUNDAY TO WEDNESDAY, SEPTEMBER 14TH TO 17TH.

Newcomen Society.—Summer meeting at Liverpool.

FRIDAY TO SUNDAY, SEPTEMBER 19TH TO 21ST.

Women's Engineering Society.—Lady Margaret Hall, Oxford. Eighth annual conference.

FRIDAY, OCTOBER 31ST.

Overhead Lines Association.—Annual conversazione.

Land Improvement Exhibition in Czechoslovakia, 1931.—The Czechoslovak Ministry of Agriculture, acting in consultation with the chief official, public and other bodies concerned with land improvement, drainage, civil engineering, &c., has started the preliminary arrangements for holding a land improvement exhibition in 1931. The exhibition, which will form part of the annual exhibition of the Agricultural League, will take place during the International Agricultural Congress at the end of May and the beginning of June in Prague. It will represent the activities of the various schools, institutions, public offices and other bodies concerned with land improvement, as well as factories, the output of which is connected with it, and it will be supplemented by meetings and discussions, as well as by visits to inspect work in progress, &c. Further information may be obtained from the Agricultural League at Prague.